FINAL

SUPPLEMENTAL

PROGRAMMATIC ENVIRONMENTAL ASSESSMENT

for

FISHERIES RESEARCH CONDUCTED AND FUNDED

by the

NORTHEAST FISHERIES SCIENCE CENTER

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Prepared For:
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Prepared by:

ECO49 Consulting LLC
907-903-9714
www.ECO49.com

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ACRONYMS AND ABBREVIATIONS

Acronym	Definition
ABC	Acceptable Biological Catch
ACA	Atlantic Coastal Fisheries Cooperative Management Act
ACDP	Acoustic Doppler Profiler
ASF	Atlantic Salmon Federation
ASL	above sea level
ASMFC	Atlantic States Marine Fisheries Commission
AUV	Autonomous Underwater Vehicle
BiOp	Biological Opinion
BMSY	Stock biomass needed for maximum sustainable yield
BTS	Bottom Trawl Survey
Centers	Fisheries Science Centers
CEQ	Council on Environmental Quality
CITES	Convention on International Trade in Endangered Species
CFR	Code of Federal Regulations
COASTSPAN	Cooperative Atlantic States Shark Pupping and Nursery
CS	Chief Scientist
CSVI	Community Social Vulnerability Indicators
CTD	Conductivity, Temperature, and Depth
CZMA	Coastal Zone Management Act
D	Depleted under the MMPA
DAS	days at sea
dB	decibels
DelMarVa	Delaware-Maryland-Virginia
DFO	Department of Fisheries and Oceans Canada
DHRA	Designated Habitat Research Area
DOSITS	Discovery of Sound in the Sea
DPS	Distinct Population Segment
E	Endangered under the ESA
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EO	Executive Order
ESA	Endangered Species Act
fm	fathom
FMP	Fishery Management Plan
FONSI	Finding of No Significant Impact
FR	Federal Register
ft	feet
GARFO	Greater Atlantic Regional Fisheries Office
GAMMS	Guidelines for Assessing Marine Mammal Stocks

Acronym	Definition
GB	Georges Bank
GOM	Gulf of Maine
GPS	Global Positioning System
HabCam	Habitat Camera
HAPC	Habitat Areas of Particular Concern
HMA	Habitat Management Area
HMS	Highly Migratory Species
Hz	hertz
ICES	The International Council for the Exploration of the Sea
ICCAT	International Commission for Conservation of Atlantic Tunas
ICUN	International Union for Conservation of Nature
IHA	Incidental Harassment Authorization
in.	inch
ITA	Incidental Take Authorization
ITR	Incidental Take Regulation
kg	kilograms
kHz	kilohertz
km	kilometers
km^2	square kilometers
LCMA	Lobster Conservation Management Areas
LME	Large Marine Ecosystem
LOA	Letter of Authorization
LOF	List of Fisheries
m	meters
µPa	microPascal
mi	miles
mi^2	square miles
MAB	Mid-Atlantic Bight
MAFMC	Mid-Atlantic Fishery Management Council
MBTA	Migratory Bird Treaty Act
MDMR	Maine Department of Marine Resources
MMPA	Marine Mammal Protection Act
MSA	Magnuson-Stevens Fishery Conservation and Management Act
M/SI	Mortality/Serious Injury
NAO	NOAA Administrative Order
NASF	North Atlantic Salmon Fund
NE	Northeast
NEAMAP	Northeast Area Monitoring and Assessment Program
NEFMC	Northeast Fishery Management Council
NEFOP	Northeast Fisheries Observer Program
NEFSC	Northeast Fisheries Science Center
NEPA	National Environmental Policy Act

Acronym	Definition
NHPA	National Historic Preservation Act
NL	not listed under the ESA
NOA	Notice of Availability
NS	Not strategic under the MMPA
nm	nautical mile
NMFS	National Marine Fisheries Service
NMSA	National Marine Sanctuaries Act
MML	National Marine Mammal Laboratory
NOAA	National Oceanic and Atmospheric Administration
NOS	National Ocean Service
NRC	National Research Council
OCS	Outer Continental Shelf
OFL	Overfishing Limit
OHA2	Omnibus Essential Fish Habitat Amendment 2
OMAO	Office of Marine Aviation and Operations
ONMS	Office of National Marine Sanctuaries
OOD	Officer on Deck
OPR	Office of Protected Resources
PBR	Potential Biological Removal
PEA	Programmatic Environmental Assessment
PTS	Permanent Threshold Shift
RFFAs	Reasonably Foreseeable Future Actions
rms	root mean square
ROV	Remotely Operated Vehicle
RSA	Research Set-Aside
S	Strategic under the MMPA
SAFMC	South Atlantic Fishery Management Council
SAR	Stock Assessment Report
SHPO	State Historic Preservation Offices
SI	serious injury
SPEA	Supplemental Programmatic Environmental Assessment
SNE	Southern New England
t	tons
TAC	Total Allowable Catch
TED	Turtle Excluder Device
TTS	Temporary Threshold Shift
U.S.	United States
ww	whole weight
VIMS	Virginia Institute of Marine Science

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EXECUTIVE SUMMARY

BACKGROUND AND NEPA COMPLIANCE

This Supplemental Programmatic Environmental Assessment (SPEA) addresses fisheries and ecosystem research activities proposed by the Northeast Fisheries Science Center (NEFSC) for the period 2021-2026). The NEFSC previously analyzed the potential environmental effects of fisheries and ecosystem research for the period 2016-2021 and, in July 2016, published a Final Programmatic Environmental Assessment (PEA) for Fisheries Research Conducted and Funded by the NEFSC (NMFS 2016b). A Finding of No Significant Impact (FONSI) was signed on August 3, 2016. The 2016 PEA provides baseline descriptions of the physical, biological and human environments and analyses of the potential consequences of alternative approaches to fisheries and ecosystem research.

Concurrent with the 2016 PEA, NEFSC applied to NMFS for regulations and a five-year Letter of Authorization (LOA) for the incidental taking of marine mammals pursuant to Section 101(a)(5)(A) of the MMPA (Appendices C and E of (NMFS 2016b)). NMFS published the final rule and LOA authorizing the Taking Marine Mammals Incidental to Northeast Fisheries Science Center Fisheries Research in August 2016 (80 Federal Register [FR] 53016).

This executive summary is a synopsis of the contents of the NEFSC Fisheries and Ecosystem Research Final Supplemental PEA (SPEA). This SPEA addresses research activities that are proposed in the foreseeable future. Proposed research activities identified and analyzed within the Preferred Alternative will be subject to National Environmental Policy Act (NEPA) compliance review on a regular basis to determine whether activities conducted are within the scope of activities analyzed in this SPEA. Proposed research not identified and analyzed in this SPEA or the original 2016 PEA will be subject to a separate NEPA compliance review, the level of which will be determined when an application is submitted.

A Notice of Availability (NOA) for draft SPEA (NMFS 2020c)was published in the Federal Register on September 18, 2020 (85 FR 58339). The public comment period closed on October 19, 2020. One comment letters was received. The Virginia Department of Environmental quality had no concerns with the Draft SPEA.

Following release of the Final SPEA, NMFS will make its decision concerning the Preferred Alternative for NEFSC research. NMFS will issue the Record of Decision approximately one month after the Final SPEA is released to the public. This decision document will conclude the NEPA process on the proposed action.

PURPOSE AND NEED

The federal action to be analyzed under this SPEA is the proposed continuation of NEFSC fisheries research activities. The purpose of NEFSC fisheries research is to produce scientific information necessary for the management and conservation of living marine resources in the NMFS Northeast Region. NEFSC's research is needed to promote both the long-term sustainability of the resource and the recovery of certain species, while generating social and economic opportunities and benefits from their use. Each of the research activities requires specific authorizations or permits including an authorization under the MMPA. The issuance of permits and the MMPA authorization are components of the federal action covered under this supplemental NEPA review.

The intent of this SPEA is to evaluate potential direct, indirect and cumulative effects of unforeseen changes in research that were not analyzed in the 2016 PEA, or new research activities. Where necessary, updates to certain information on species, stock status or other components of the affected environment that may result in different conclusions from the 2016 PEA are presented in this analysis.

This SPEA also provides a basis for compliance with other statutes including the MMPA, ESA, National Marine Sanctuaries Act (NMSA), National Historic Preservation Act (NHPA), Coastal Zone Management Act, Executive Order 12114 (EO12114), Migratory Bird Treaty Act (MBTA), and Essential Fish Habitat (EFH)/MSA, as well as to support consultation with native tribes within the Action Area.

DESCRIPTION OF ALTERNATIVES

The 2016 PEA Preferred Alternative (referred to in the 2016 PEA as Alternative 2) was chosen and provided the framework under which fisheries research has been conducted since 2016 (NMFS 2016b). The range of alternatives evaluated in this SPEA present the status quo/no action (i.e., current research) as Alternative 1 while Alternative 2 presents modifications to current research or new research activities that are planned for the future (i.e., 2021–2026). New future research proposed under Alternative 2 was not previously analyzed in the 2016 PEA. Table ES-1 summarizes research surveys by type or gear for a simple comparison of Alternatives 1 and 2. Table ES-2 summarizes the proposed mitigation measures for the Preferred Alternative (Alternative 2).

AFFECTED ENVIRONMENT

Chapter 3 of the 2016 PEA (NMFS 2016b) provides a comprehensive summary of physical, biological and socioeconomic resources that characterize the affected environment within the Project Area. As a supplement to the 2016 PEA, this SPEA describes updates and brings forward for analysis, only those resources that have exhibited a change in status or condition, or that may be affected by the new proposed research activities that were not previously considered in the 2016 PEA. Impacts to the resources described below are brought forward and summarized in tables below under Environmental Effects.

Physical Resources

Since 2016, there have been minor changes to special resources or areas within the Project Area including: EFH, Habitat Areas of Particular Concern (HAPC), Closed Areas, and the Stellwagen Bank, and Monitor National Marine Sanctuary (NMS) (See Sections 3.1 and 4.4.1).

Fish

<u>ESA-Listed Fish</u>

ESA-listed fish species requiring analysis in this SPEA include: Atlantic salmon (Gulf of Maine [GOM] Distinct Population Segment [DPS]); Atlantic sturgeon; shortnose sturgeon; smalltooth sawfish; and oceanic whitetip shark (see Sections 3.2.1 and 4.4.2). Smalltooth sawfish are extremely rare north of Florida and are not expected to interact with NEFSC research studies.

TABLE ES-1. SUMMARY OF RESEARCH BY ALTERNATIVE INCLUDING NEW PROPOSED ACTIVITIES UNDER ALTERNATIVE 2 AS SHOWN IN BOLD ITALICS

Survey Using Gear Type	**Alternative 1** ***No Action, Status Quo***	**Alternative 2**[1] ***Preferred Alternative*** **Future Research**
Bottom Trawl Gear	• Benthic Habitat Survey • Northeast Area Monitoring and Assessment Program (NEAMAP) • Standard Bottom Trawl Surveys (BTS) • Habitat Mapping Survey • State Trawl Fisheries • Northern Shrimp Survey • Northeast Fisheries Observer Program (NEFOP) • NEFSC Trawl Comparison Research and Standardization	**Same as Alt. 1 plus**: • Community Structure Study[2] • Marine Resources Survey[2] • Herring Survey[2] • ***Fish Collection*** • ***Flatfish Surveys*** • ***Conservation Engineering Projects***[3] • ***Tagging Projects***[4]
Pelagic Trawl Gear	• Penobscot Maine Estuarine & Ecosystem Survey • Deepwater Biodiversity Survey	**Same as Alt. 1 plus**: • ***Atlantic Herring Survey*** • ***Atlantic Salmon Survey*** • ***Northeast Integrated Pelagic Mid-water Trawls*** • ***Catchability Surveys***[5] • ***NEFOP Mid-water Trawl Observer Training***
Longline Surveys	• Apex Predators Bottom Longline Coastal Shark Survey • Apex Predators Pelagic Nursery Grounds Shark Survey • COASTSPAN Longline and Gill net Surveys[6] • Cooperative Longline Projects[7]	**Same as Alt. 1 plus:** • ***Apex Predators Pelagic Longline Shark Survey*** • ***NEFOP Bottom Longline Observer Training***
Dredge Surveys	• Annual Standard Sea Scallop Survey • Scallop Closed Area Survey[8] • Research Set-Aside Scallop Surveys • Surfclam & Quahog Surveys • NEFOP Scallop Dredge Survey Observer Training	**Same as Alt. 1 plus:** • ***Conservation Engineering Project***[9]

Survey Using Gear Type	Alternative 1 *No Action, Status Quo*	Alternative 2[1] *Preferred Alternative* Future Research
Other Gear and Survey Type	• Coastal Maine Telemetry Network • Deep Sea Coral Survey • Diving Operations • Gulf of Maine Ocean Observing System Mooring Cruise • NEFOP Gillnet Observer Training • Rotary Screw Trap Survey • Research Set-Aside Gillnet Monkfish Surveys • Continuous Plankton Recorder Transect Surveys Gulf of Maine[10]	**Same as Alt 1. Plus:** • ***Maine Estuaries Diadromous Survey*** • ***Nutrients and Frontal Boundaries*** • ***Ocean Acidification*** • ***Autonomous Underwater Vehicle (AUV) Pilot Studies*** • ***Finfish Aquaculture Trawling*** • ***Delaware-Maryland-Virginia (DelMarVa) Habitat Characterization*** • ***DelMarVa Reefs Survey*** • ***Fish Collection*** • ***Opportunistic Hydrographic Sampling*** • ***Tagging Projects (Gillnets, Hook & Line, Rod and Reel)*** • ***Passive Acoustic Monitoring*** • ***Trap and pot conservation engineering (Protected Species – rope- less trap lines)[11]*** • ***Surveys Using Pots & Traps[12]***

[1] Proposed activities that did not occur over the period 2016-2018 are shown in bold italics. There was a significant reduction in research during 2016–2018 due to several factors including reduced funding. The 2016 PEA analyzed a wide range of research, some of which was not fully funded or conducted. These projects are now listed under Alternative 2 for future research (see Section 2.2).
[2] Status Quo projects that were never fully funded in the past and never conducted, but may occur under the Preferred Alternative
[3] Such as trawl gear work and selectivity studies in small mesh fisheries and squid.
[4] Winter flounder migration patterns.
[5] Monkfish, longfin squid and other species.
[6] Also uses gillnets.
[7] Such as Western Central Gulf of Maine hard bottom longline survey.
[8] Scallop abundance and distribution.
[9] Such as scallop dredge finfish and turtle excluder devices, and hydrodynamic dredge development.
[10] Monthly CPR transects from Maine to Nova Scotia
[11] Ropeless lobster pot float lines (acoustic release devices) for protected species research.
[12] Such as scup and black sea bass pot surveys.

TABLE ES-2. MITIGATION AND MONITORING MEASURES FOR THE PREFERRED ALTERNATIVE

Measures	Preferred Alternative (Alternative 2)
General Measures Applicable to All Surveys	• Coordination and Communication: In advance of each survey, coordination with the NOAA OMAO or other relevant parties to ensure clear understanding of the mitigation measures and the manner of their implementation. Conduct briefings at the outset of each survey and as necessary with the ship's crew and coordinate daily as necessary during survey cruises. Chief scientist (CS) to coordinate with Officers on Deck (OOD) or equivalent to ensure procedures are understood. • Protected Species Training: Conduct a formalized protected species training program for all crew members that are part of NEFSC-affiliated research and cooperative research. Training will include topics such as monitoring and sighting protocols, species identification, decision-making factors avoiding take, procedures for handling and documenting protected species interactions, and reporting requirements. • Vessel Speed and Distance: If vessel crew or dedicated marine mammal observers sight marine mammals that may intersect the vessel, they will immediately communicate with the bridge for appropriate course alteration or speed reduction as possible. If a vessel 65 ft or longer is traveling within a North Atlantic Right Whale Seasonal Management Area, do not exceed 10 knots. When practicable, all NEFSC vessels traveling within a Dynamic Management Area shall not exceed 10 knots. Maintain a distance of 500 m and 100 m from North Atlantic right whales and other large whales, respectively. • Handling Procedures: Implement NEFSC established protocols to reduce interaction with marine mammals following a step-wise order; 1) ensure health and safety of crew; depending on how and where an animal is hooked or entangled, take action to prevent further injury to the animal; 3) take action to increase the animal's chance of survival; and 4) record detailed information on the interaction, actions taken and observations of the animal throughout the incident. • Genetic Sampling: If a mortality of a bottlenose dolphin of unknown origin occurs due to entanglement, NEFSC must photograph the dorsal fin to submit to the Regional Stranding Coordinator and request expedited genetic sampling for stock determination.
Surveys Using Trawl Gear	• Conduct trawl operations upon arrival on station to the extent practicable. • For all beam, mid-water, and bottom trawl, the OOD, CS or other member) and crew standing watch on the bridge will scan for protected species using binoculars during all daytime operations. • Initiate protected species watches (visual observation) 15 minutes prior to sampling within 1 nm of of the station. Scan the surrounding waters with the naked eye and rangefinding binoculars. • If protected species are sighted within 1 nm of the station in the 15 minutes before setting the gear, the OOD may decide to implement the "move-on" rule and transit to a different section of the sampling area. Trawl gear will not be deployed if protected species are sighted near the ship unless there is no risk of interaction as determined by the OOD or CS. • After moving on, if protected species are still visible from the vessel and appear at risk, the OOD may decide to move again or skip the station. The OOD and CS may discuss strategies for avoid takes of these species. • If trawling is delayed because of protected species presence, NEFSC may resume only after there are no sightings for 15 minutes within 1nm of sampling location. • Continue visual monitoring while gear is deployed. If protected species are sighted before gear retrieval, the CS, watch leader, or OOD will determine the best action to minimize interactions with animals. • During nighttime operations, observe with the naked eye and any available vessel lighting.

Measures	Preferred Alternative (Alternative 2)
Surveys Using Trawl Gear, cont'd.	• If deploying plankton or other small net prior to trawl gear, continue visual observations until trawl gear is ready to be deployed. • Conduct standard tow durations of no more than 30 minutes at target depth for distances less than 3 nm. The exceptions to the 30-minute tow duration are the Atlantic Herring Acoustic Pelagic Trawl Survey and the Deepwater Biodiversity Survey where total time in the water (deployment, fishing, and haul-back) is 40 to 60 minutes and 180 minutes, respectively. • Clean gear prior to deployment. Empty gear as quickly as possible to ensure no marine mammals are entangled.
Surveys Using Dredge Gear	• Conduct dredge operations upon arrival on station to the extent practicable. • For all scallop and hydraulic clam dredges, the OOD, CS or other crew members and crew standing watch on the bridge will scan for marine mammals using binoculars during all daytime operations. • Initiate protected species watches prior to sampling. Scan the surrounding waters with the naked eye and range finding binoculars. • If protected species are sighted within 1 nm 15 minutes before setting the gear, the OOD may decide to implement the "move-on" rule and transit to a different section of the sampling area. Dredge gear will not be deployed if marine mammals are sighted near the ship unless there is no risk of interaction as determined by the OOD or CS. • After moving on, if protected species are still visible from the vessel and appear at risk, the OOD may decide to move again or skip the station. The OOD and CS may discuss strategies for avoid takes of these species. • If dredging is delayed because of marine mammal presence, it only resumes when the animals have not been sighted for 15 minutes. • Continue visual monitoring while gear is deployed. If protected species are sighted before gear retrieval, the CS, watch leader, or OOD will determine the best action to minimize interactions with animals. • During nighttime operations, observe with the naked eye and any available vessel lighting. • Conduct standard tow durations of no more than 15 minutes at target depth for distances less than 1 nm for scallop dredging and 10 minutes for clam dredging. • Clean gear prior to deployment. Empty gear as quickly as possible to ensure no protected species are entangled.
Longline Surveys	• Deploy longline gear as soon as practicable upon arrival on station. • Initiate visual observation for protected species no less than 15 minutes prior to deployment and retrieval of gear. Scan surrounding waters with the naked eye and binoculars (or monocular). Conduct visual observations during nighttime surveys using the naked eye and available vessel lighting. • If protected species are sighted within 15 minutes before setting gear, implement the move-on rule if species appears at risk of interaction with gear. If, after moving on, protected species are still visible from the vessel, NEFSC will use professional judgment about whether to move again or skip the station. • For Apex Predators Bottom Longline Coastal Shark Survey, if one or more marine mammals are observed within 1nm of station within 15 minutes before gear deployment, transit to a different section of sampling area to maintain minimum distance of 1nm from marine mammal(s). Use professional judgment whether to move again or forego sampling if marine mammal(s) remain within 1nm of sampling location. • If gear deployment or retrieval is suspended due to presence of marine mammals, resume operations only after there are no sightings for at least 15 minutes within 1nm of sampling location. • Chumming is prohibited.

Measures	Preferred Alternative (Alternative 2)
Rotary Screw Trap Surveys	• Conduct rotary screw trap deployments as soon as is practicable upon arrival at the sampling site. • Initiate visual observation for marine mammals in the area prior to setting and retrieval of the rotary screw trap gear. If marine mammals are observed in the sampling area, NEFSC shall suspend or delay the sampling. NEFSC may use best professional judgement in making this decision. • Tend to the trap on a daily basis to monitor for marine mammal interactions with the gear. • If the rotary screw trap catches a marine mammal, NEFSC shall carefully remove and release the animal as soon as possible.
Pot/Trap Surveys	• Same protocols as longline.
Fyke Net Surveys	• Deploy gear as soon as practicable upon arriving at station. • Conduct monitoring and retrieval of gear every 12- to 24-hour soak period. • A 2-m fyke net will be fitted with a Marine Mammal Excluder Device (MMED). • If marine mammals are within 100 m of setting location, consider moving. If there is risk of interaction with marine mammals, retrieve gear.
Gillnet Surveys	• Conduct gillnet operations upon arrival on station to the extent practicable. • For all gillnet deployments, the OOD, CS or other member and crew standing watch on the bridge will scan for marine mammals and sea turtles using binoculars during all daytime operations. • Initiate marine mammal and sea turtle watches upon arrival on station. Scan the surrounding waters with the naked eye and range finding binoculars. • Deploy acoustic pingers in areas where required for commercial fisheries. • If marine mammals or sea turtles are sighted within 1 nm 15 minutes before setting the gear, the OOD may decide to implement the “move-on” rule and transit to a different section of the sampling area. Gillnet gear will not be deployed if sea turtles or marine mammals are sighted near the ship unless there is no risk of interaction as determined by the OOD or CS. • After moving on, if marine mammals or sea turtles are still visible from the vessel and appear at risk, the OOD may decide to move again or skip the station. The OOD and CS may discuss strategies **to** avoid takes of these species. • If placement of the gillnet is delayed because of sea turtle or marine mammal presence, operations only resume when the animals have no longer been sighted or are no longer at risk. If a marine mammal or sea turtle is sighted during the soak and appears to be at risk of interaction with the gear, then the gear is pulled immediately. • Continue visual monitoring while gillnet is soaking. If marine mammals or sea turtles are sighted before gear retrieval, the CS, watch leader, or OOD will determine the best action to minimize interactions with animals. • Clean gear prior to and during deployment. Empty gear as quickly as possible to ensure no marine mammals or sea turtles are entangled. • For the COASTSPAN gillnet surveys, NEFSC shall actively monitor for potential bottlenose dolphin entanglements by hand-checking the gillnet every 30 minutes.

Target Fish and Highly Migratory Species (HMS)

The 2016 PEA (Table 3.2-1) identified 35 target species encountered during NEFSC-affiliated research activities (2008–2012) that were listed as overfished or subject to overfishing at that time, or for which the average annual research catch exceeded 2,200 pounds (1.1 ton or 1 mt). Since the 2016 PEA analysis, the list of fish has been expanded to include more species or to break out specific stocks to provide a comprehensive evaluation of the potential effects of research on fish species. A complete table comparing research catch to commercial and recreational catch is provided in Appendix B.

Since publication of the 2016 PEA (NMFS 2016b), several amendments to the 2006 Consolidated Atlantic HMS FMP have been implemented or published. In addition, for certain HMS, quotas or retention limits have been established and opening dates finalized (see Section 3.2.1.3).

Marine Mammals

The following NE Large Marine Ecosystem (LME) species require analysis in this SPEA due to their status under the ESA; changes in management or environmental conditions and/or the possibility of takes occurring during NEFSC research: North Atlantic right whale; fin whale; minke whale; sperm whale; northern bottlenose whale, Cuvier's beaked whale; Risso's dolphin; long-finned pilot whale; short-finned pilot whale; Atlantic white-sided dolphin; white-beaked dolphin; short-beaked common dolphin; Atlantic spotted dolphin; striped dolphin; bottlenose dolphin (migratory and offshore stocks); harbor porpoise, harbor seal and grey seal.

January 27, 2016, NMFS designated 29,763 nm^2 of marine habitat in the GOM and Georges Bank and off the Southeast U.S. coast as critical habitat (81 FR 4837). New information and a BiOp on North Atlantic right whales are forthcoming (see Section 3.2.2.1).

Seabirds, Sea Turtles, and Invertebrates

The populations of seabird species have not significantly changed and potential impacts from future fisheries and ecosystem research are not expected to result in different conclusions from those presented in the original 2016 PEA impact assessment (see Section 3.2.3). NEFSC is authorized to capture: loggerhead sea turtles, Kemp's ridley sea turtles, green sea turtles; and leatherback sea turtles. Therefore, the potential impacts of the alternative on this species are discussed in Chapter 4. Due to recent status updates (see Section 3.2.5), three invertebrate species are evaluated in Chapter 4 for potential impacts due to research including America lobster, northern shrimp and horseshoe crab.

Vegetation

Johnson's seagrass (*Halophilia johnsonii*) was listed as threatened in 1998 (63 FR 49035) and critical habitat was designated in 2000 (65 FR 17786). Johnson's seagrass is rare and limited in its range which primarily includes the east coast of Florida from Sebastien Inlet to central Biscayne Bay. In April of 2000, ten areas off of the Florida coast were designated as critical habitat for Johnson's seagrass (65 FR 177786). COASTSPAN surveys occasionally set longline gear in these areas from small boats.

Social and Economic Environment

The NEFSC fisheries and ecosystem research activities have direct and indirect influence on the economics of United States (U.S.) communities and ports in which they operate. As described in the 2016

PEA (NMFS 2016b) NEFSC research NEFSC carries out research in facilities located in Massachusetts, Rhode Island, Connecticut, New Jersey, Washington DC, and Maine. Through direct expenditures on fisheries and ecosystem research, NEFSC contributes to the communities and ports in these regions.

ENVIRONMENTAL EFFECTS

Consistent with the approach used in the 2016 PEA (NMFS 2016b), the criteria described in Chapter 4 of this SPEA (Table 4-1) are used to evaluate SPEA Alternatives 1 and 2 those resources identified in Chapter 3 needing additional evaluation based on new information or the proposed scope of new research proposed 2021–2026.

Effects of the Status Quo/No Action Alternative

Effects on the Physical Environment

Table ES-3 summarizes the potential effects of the Status Quo/No Action Alternative on elements of the physical environment that have been added or updated since the 2016 PEA.

TABLE ES-3. SUMMARY OF POTENTIAL IMPACTS OF THE STATUS QUO/NO ACTION ALTERNATIVE ON THE PHYSICAL ENVIRONMENT

Environment	Potential Impact of Status Quo/ No Action Alternative	Description
Essential Fish Habitat ***Stellwagen Bank DHRA***	Minor *Beneficial*	The combination of new and revised EFH conservation areas, habitat management areas and creation of habitat research areas (DHRAs) implemented due to Amendment OHA2 is anticipated to minimize adverse impacts to EFH from the effects of fishing. The recent court settlement to ban gillnetting in two areas will also further protect EFH. While OHA2 reopened some locations to commercial fishing (i.e., Nantucket Lightship and Closed Area 1), the overall effects are expected to be balanced by beneficial effects due to this change**.**
Closed Areas	Minor *Beneficial*	See EFH above.
National Marine Sanctuaries ***Monitor NMS Boundary Expansion***	Minor *Beneficial*	In 2016, ONMS published a notice of intent to expand boundaries of the sanctuary. The expansion could preserve nationally significant historic wreck sites which would also likely benefit physical resources. However, the expansion is still only a proposal and has not been implemented.

Effects on ESA-Listed Fish

Table ES-4 summarizes the potential effects of the Status Quo/No Action Alternative on ESA-listed fish that have been added or updated since the 2016 PEA.

TABLE ES-4. SUMMARY OF POTENTIAL IMPACTS OF THE STATUS QUO/NO ACTION ALTERNATIVE ON ESA-LISTED FISH

ESA-Listed Species	Potential Impact of Status Quo/No Action Alternative		Description
	Mortality from Surveys	Disturbance Due to Sound Sources	
Atlantic Salmon, GOM DPS (E)	Minor *Adverse*	No effect	No change in ESA-listed status. The directed commercial fishery for Atlantic salmon in West Greenland ended in 2018 which will increase survival primarily in Canada, but also the GOM DPS. Tagging research project in Greenland by NEFSC takes up to 100 fish a year by trolling which are not necessarily ESA-listed fish. The recent tagging studies resulted in only one salmon tagged from ESA-listed populations suggesting that impacts from the Greenland study and total takes from the GOM DPS would be expected to be a minor adverse effect.
Atlantic Sturgeon **GOM southern DPS (T)** **All other DPSs (E)**	Minor *Adverse*	No effect	On Aug 17, 2017, critical habitat was designated or all DPSs. Incidental takes have occurred (Table 4-7), but none were lethal.
Shortnose Sturgeon	Minor *Adverse*	No effect	Shortnose sturgeon have not been historically taken during surveys (NMFS 2016a). However, future catch of this species during trawl or fyke net surveys in coastal areas such as the Penobscot and Hudson River estuaries is possible. Effects would be minor adverse.
Giant Manta Rays	Minor *Adverse*	No effect	Giant manta rays are targeted and caught as bycatch, with high rates of removal from industrial purse-seine and artisanal gillnet fisheries (83 FR 2916). These mortalities generally occur outside the proposed Research areas but future catch is possible. Therefore, NEFSC research may, but is not likely to incidentally catch giant manta rays during research. Effects would be minor adverse.

Effects on Target Species

Table ES-5 summarizes the potential effects of the Status Quo/No Action Alternative on target fish since the 2016 PEA. Table ES-6 summarizes potential effects of the Status Quo/No Action Alternative on HMS.

TABLE ES-5. SUMMARY OF POTENTIAL IMPACTS OF THE STATUS QUO/NO ACTION ALTERNATIVE ON TARGET FISH

Target Fish	Potential Impact of Status/Quo/No Action Alternative		Description
	Mortality from Surveys	Disturbance Due to Sound Sources	
Alewife (River herring)	Minor *adverse*	No Effect	No change in status; however, review for Alewife and Blueback Herring under the ESA (15 August 2017). Depleted status for the coast-wide meta-complex. Mortality from research surveys in 2017 (Table 4-9) was 88% of the total catch. Research catch has remained steady at around 3 tons over the period 2015-2017, but commercial catch dropped drastically.
Atlantic cod (GBK and GOM stocks)	Minor *adverse*	No Effect	Low level mortality from 2017 research surveys (Table 4-9) is a small percentage of the ACL and is not expected to result in adverse changes at the population level.
Atlantic halibut	Minor *adverse*	No Effect	Populations have been increasing, overfishing is not occurring. Low level mortality from 2017 research surveys (Table 4-9) is a small percentage of the ACL and is not expected to result in adverse changes at the population level.
Atlantic herring	Minor *adverse*	No Effect	Potential change in status; approaching overfished. 2017 research catch was 0.01% of total catch (Table 4.9).
Atlantic mackerel	Minor *adverse*	No Effect	Change in status. Overfished and overfishing is occurring. 2017 research catch was 0.07% of total catch but was higher than the 2008-2012 average of 0.02% (Table 4-9).
Atlantic wolffish	Minor *adverse*	No Effect	No change in status however the population is overfished. Low level mortality from research surveys (Table 4-9) is a small percentage of the ACL and is not expected to result in adverse changes at the population level.
Ocean pout	Minor *adverse*	No Effect	No change in status; continue rebuilding. Low level mortality from research surveys (Table 4-9) is a small percentage of the ACL and is not expected to result in adverse changes at the population level.
Red hake (southern stock only)	Minor *adverse*	No Effect	Change in status. Overfished and overfishing is occurring. 2017 research catch was about 0.5% of total catch, and less than the 2008-2012 percentage (Table 4-9)

Target Fish	Potential Impact of Status/Quo/No Action Alternative		Description
	Mortality from Surveys	**Disturbance Due to Sound Sources**	
Striped bass	No Effect	No Effect	Potential change in status. NEFSC (2019) states stock is overfished. 2017 research catch was less than 0.001% of total catch (Table 4-9).
Thorny skate	Minor *adverse*	No Effect	ESA status review published on February 24, 2017 concluded the thorny skate is not in danger of extinction and listing is not warranted.
Weakfish	Minor *adverse*	No Effect	Change in status. Stock is now considered depleted[1].
Windowpane flounder (GB and GOM stocks)	Minor *adverse*	No Effect	Change in status in 2016 from overfishing to no overfishing. Low level mortality from research surveys (Table 4-9) is a small percentage of the ACL and is not expected to result in adverse changes at the population level.
Winter flounder (blackback)	Minor *adverse*	No Effect	SNE/MAB stock: Overfished/overfishing; GOM stock: unknown. Low level mortality from research surveys (Table 4-9) is a small percentage of the ACL and is not expected to result in adverse changes at the population level.
Witch flounder (grey sole)	Minor *adverse*	No Effect	Potential change in status. Overfishing is currently unknown. Low level mortality from research surveys (Table 4-9) is a small percentage of the ACL and is not expected to result in adverse changes at the population level.
Yellowtail flounder	Minor *adverse*	No Effect	Change in status. All stocks are overfished and overfishing is occurring. Low level mortality from research surveys (Table 4-9) is a small percentage of the ACL and is not expected to result in adverse changes at the population level.

[1] ASMFC (2016) indicates weakfish has been depleted for the past 13 years. A fish stock is considered depleted when it falls below a spawning stock biomass threshold of 30%.

Based on data from 2015, NMFS assessed the magnitude of target fish mortality by comparing the amount of fish caught in NEFSC research to the amount caught in commercial fisheries including the estimated catch from recreational fisheries (estimates are only available for the most popularly harvested species). Estimated discard data from 2015 were also included as part of the total mortality in commercial catch only (data on discards associated with recreational catch are not currently available). For species with Annual Catch Limits (ACLs), research catch is a very small percentage of the ACL. In all cases except one (yellowtail flounder-SNE/MA stock) the research catch is less than 1% of the ACL (see Table 4-9). For these species, the impact of removals from NEFSC research activities would be considered minor adverse because it occurs but would not be expected to significantly affect future abundance. For species without an ACL, the 2015 research catch was generally less than 1% of the total catch (research and commercial catch combined). While the research catch of alewife has remained

steady at around 3 tons, the commercial and recreational catch of alewife was around 650 tons in 2015 and 2016 but fell to less than 0.5 ton in 2017 (see also Appendix B).

TABLE ES-6. SUMMARY OF POTENTIAL IMPACTS OF THE STATUS QUO/NO ACTION ALTERNATIVE ON HMS

HMS	Potential Impact of Status/Quo/No Action Alternative		Description
	Mortality from Surveys	**Disturbance Due to Sound Sources**	
Sharks			
Dusky	Moderate *adverse*	No effect	The population is overfished and NMFS estimates 100 years to rebuild by 2107 (NMFS 2020a). In 2018 the Apex Predator Bottom Longline Coastal Shark survey caught 309 dusky sharks, 52 of which suffered mortality (Table 4-11). This is one of the few fishery-independent surveys used to assess this population and an HMS Exempted Fishing Permit is obtained for each survey. Because the dusky shark population will take so long to rebuild, mortality from surveys is determined to be moderate adverse.
Blacknose	Minor *adverse*	No effect	NEFSC surveys over the period 2017-2018 captured a total of 303 blacknose sharks, of which only 12 suffered mortality (Table 4-11). In both 2017 and 2018 the commercial quota was 17.2 mt dw, of which only 45 and 30 percent were used, respectively, per year. Therefore, mortality of fewer than 20 sharks over a two-year period is considered a minor adverse effect.
Shortfin mako	No effect	No effect	Not typically encountered during NEFSC surveys; none were caught in 2017 and 2018 surveys (Table 4-11).
Oceanic whitetip	No effect	No effect	Listed as threatened under the ESA January 30, 2018 (80 FR 4153). Not typically encountered during NEFSC surveys; none were caught in 2017 and 2018 surveys (Table 4-11).
Scalloped hammerhead	Minor *adverse*	No effect	NEFSC surveys over the period 2017-2018 captured a total of 303 scalloped hammerhead sharks, over 1/3 of which (130) suffered mortality (Table 4-11). In both 2017 and 2018 the commercial quota for hammerheads was 27.1 mt dw, of which only 34 and 46 percent were used, respectively, per year. Therefore, mortality of 130 sharks totaling less than 0.2 mt ww over a two-year period would be a minor adverse effect.
Porbeagle	No effect	No effect	Not typically encountered during NEFSC surveys; none were caught in 2017 and 2018 surveys (Table 4-11).

HMS	Potential Impact of Status/Quo/No Action Alternative		Description
	Mortality from Surveys	Disturbance Due to Sound Sources	
Sandbar	Minor *adverse*	No effect	NEFSC surveys over the period 2017-2018 captured a total of 4,347 sandbar sharks, of which only 24 suffered mortality (Table 4-11). The biomass target for rebuilding is over 680,000 sharks so mortality of fewer than 25 over a two-year period is considered a minor adverse effect.
Tunas			
Bigeye	No effect	No effect	Not typically caught by NEFSC shark and COASTSPAN surveys.
Other Species			
Blue marlin	No effect	No effect	Not typically caught by NEFSC shark and COASTSPAN surveys.
White marlin	No effect	No effect	Not typically caught by NEFSC shark and COASTSPAN surveys.

Effects on Marine Mammals

No mortality or serious injury takes have occurred during any past NEFSC research activities and incidental takes (Level B) for acoustic or other disturbance have been below levels authorized in the 2016 LOA. Table ES-7 summarizes the potential effects of the Status Quo/No Action Alternative on ESA-listed and non-listed cetaceans.

TABLE ES-7. SUMMARY OF POTENTIAL IMPACTS OF THE STATUS QUO/NO ACTION ALTERNATIVE ON ESA-LISTED AND NON-LISTED MARINE MAMMALS

Marine Mammals	Potential Impact of Status/Quo/No Action Alternative			Discussion
	Injury or Mortality	Changes in Food Availability	Disturbance from Sound Sources	
ESA-Listed				
North Atlantic right whale	No effect	No effect	No effect	The population of this stock has not changed over the 2015-2018 period and remains below 100 individuals. The 2016 rule adjusted the take estimates from ten to zero because of the low probability of sighting or interaction with these species during most research cruises with the active acoustic instruments used in NEFSC research[1]. Disturbance takes are not expected and have not been documented.
Sperm Whale	No effect	No effect	Minor *Adverse*	Disturbance takes have not been documented in the LME over 2016-2019[2], but one take per year has been documented for offshore areas in 2017 and 2018 (Table 4-14). The 2016 rule adjusted the take estimates from ten to zero for the LME area but allows 15 disturbance takes for offshore area[1].
Fin Whale	No effect	No effect	No effect	Abundance estimates have decreased since 2016. The 2016 rule adjusted the take estimates from ten to zero. Disturbance takes are not expected and have not been documented in the LME or offshore[2].
Non-Listed LME Area Species				
Atlantic white-sided dolphin	No effect	No effect	Minor *Adverse*	No change in status or abundance estimates since 2016. Disturbance takes occur but are well below authorized levels (Table 4-13).
Common bottlenose dolphin (coastal)	Minor *Adverse*	No effect	Minor *Adverse*	Migratory coastal stock abundance estimates have decreased since 2016. One M/SI take (lethal) occurred in 2019 during a Cooperative Research cruise. Eight Level A takes are allowed over the 5-year period[1]. Disturbance takes occur but are well below authorized levels (Table 4-13).
Common bottlenose dolphin (offshore)	Minor *Adverse*	No effect	Minor *Adverse*	No change in status or abundance since 2016. Disturbance takes occur but are below authorized levels (Table 4-13).

Marine Mammals	Potential Impact of Status/Quo/No Action Alternative			Discussion
	Injury or Mortality	Changes in Food Availability	Disturbance from Sound Sources	
Cuvier's beaked whale	No effect	No effect	Minor *Adverse*	No change in status or abundance estimates since 2016. Disturbance takes occur but are below authorized levels (Table 4-13).
Dwarf/Pygmy sperm whale	No effect	No effect	Minor *Adverse*	No change in status or abundance estimates since 2016. Disturbance takes occur but are below authorized levels (Table 4-13).
Harbor Porpoise	No effect	No effect	Minor *Adverse*	No change in status or abundance estimates since 2016. Disturbance takes occur but are well below authorized levels (Table 4-13).
Humpback Whale **GOM DPS**	No effect	No effect	No effect	The West Indies DPS of which the GOM stock of humpback whale is included was delisted (81 FR 62259). The 2016 rule adjusted the take estimates from ten to zero[1]. Disturbance takes are not expected and have not been documented in the LME or offshore[2].
Long-finned Pilot Whale	No effect	No effect	Minor *Adverse*	Abundance estimates have decreased since 2016. Disturbance takes occur but are well below authorized levels (Table 4-13).
Mesoplodon beaked whales	No effect	No effect	Minor *Adverse*	No change in status or abundance estimates since 2016. Disturbance takes occur but are below authorized levels (Table 4-13).
Minke whale	No effect	No effect	No effect	Abundance estimates have decreased since 2016. The 2016 rule adjusted the take estimates from ten to zero[1]. Disturbance takes have not been documented in the LME[2].
Risso's dolphin	No effect	No effect	Minor *Adverse*	No change in status or abundance estimates since 2016. Disturbance takes occur but are below authorized levels (Table 4-13).
Short-beaked common dolphin	No effect	No effect	Minor *Adverse*	Abundance estimates have decreased since 2016. Disturbance takes occur but are well below authorized levels (Table 4-13).
Short-finned Pilot Whale	No effect	No effect	Minor *Adverse*	No change in status or abundance estimates since 2016. Disturbance takes occur but are below authorized levels (Table 4-13).

Marine Mammals	Potential Impact of Status/Quo/No Action Alternative			Discussion
	Injury or Mortality	Changes in Food Availability	Disturbance from Sound Sources	
White-beaked dolphin	No effect	No effect	Minor *Adverse*	No change in status or abundance estimates since 2016. Disturbance takes occur but are below authorized levels (Table 4-13).
Gray Seal	No effect	No effect	Minor *Adverse*	Abundance estimates have decreased since 2016. The 2016 rule adjusted the take estimates from ten to zero. Disturbance takes are not expected and have not been documented in the LME or offshore[2]. Disturbance also occurs during the Penobscot Bay pinniped haulout survey (Table 4-15).
Harbor Seal	No effect	No effect	Minor *Adverse*	No change in status or abundance estimates since 2016. Disturbance takes occur but are below authorized levels (Table 4-13). Disturbance also occurs during the Penobscot Bay pinniped haulout survey (Table 4-15).
Non-Listed Offshore Area Species				
Atlantic spotted dolphin	No effect	No effect	Minor *Adverse*	No change in status or abundance estimates since 2016. Disturbance takes occur but are below authorized levels (Table 4-14).
Common bottlenose dolphin (offshore)	No effect	No effect	Minor *Adverse*	No change in status or abundance since 2016. Disturbance takes occur but are well below authorized levels (Table 4-14).
Cuvier's beaked whale	No effect	No effect	Minor *Adverse*	No change in status or abundance estimates since 2016. Disturbance takes occur but are below authorized levels (Table 4-14).
Dwarf sperm whale	No effect	No effect	No effect	No change in status or abundance estimates since 2016. Disturbance takes are authorized, but none occurred in 2017-2019 (Table 4-14).
Long-finned pilot whale	No effect	No effect	Minor *Adverse*	Abundance estimates have decreased since 2016. Disturbance takes occur but are well below authorized levels (Table 4-14).
Mesoplodon beaked whales	No effect	No effect	Minor *Adverse*	No change in status or abundance estimates since 2016. Disturbance takes occur but are below authorized levels (Table 4-14).
Minke whale	No effect	No effect	No effect	Abundance estimates have decreased since 2016. The 2016 rule adjusted the take estimates from ten to zero[1]. Disturbance takes are not expected have not been documented in the offshore area[2].

Marine Mammals	Potential Impact of Status/Quo/No Action Alternative			Discussion
	Injury or Mortality	Changes in Food Availability	Disturbance from Sound Sources	
Northern bottlenose whale	No effect	No effect	No effect	Abundance estimates are unknown. Disturbance takes are authorized, but none occurred in 2017-2019 (Table 4-14).
Pygmy sperm whale	No effect	No effect	No effect	No change in status or abundance estimates since 2016. No disturbance takes occurred in 2017-2019 (Table 4-14).
Risso's dolphin	No effect	No effect	Minor *Adverse*	No change in status or abundance estimates since 2016. Disturbance takes occur but are below authorized levels (Table 4-14).
Rough toothed dolphin	No effect	No effect	Minor *Adverse*	No change in status or abundance estimates since 2016. Disturbance takes occur but are below authorized levels (Table 4-14).
Short-beaked common dolphin	No effect	No effect	Minor *Adverse*	Abundance estimates have decreased since 2016. Disturbance takes occur but are well below authorized levels (Table 4-14).
Short-finned pilot whale	No effect	No effect	Minor *Adverse*	No change in status or abundance estimates since 2016. Disturbance takes occur but are well below authorized levels (Table 4-14).
Striped dolphin	No effect	No effect	Minor *Adverse*	No change in status or abundance estimates since 2016. Disturbance takes occur but are well below authorized levels (Table 4-14).

[1] 80 FR 3061
[2] Source: (NEFSC 2018c, 2019b), NEFSC (2020)

Effects on Sea Turtles, Invertebrates and Vegetation

Compared to the number of incidental captures of sea turtles accounted for in the 2016 BiOp, the number of sea turtles actually taken in 2017 and 2018 is very low and none of the takes were lethal (Table 4-18). These low levels of take are anticipated to be similar under the Status Quo in future years and considering that most acoustic sources would be inaudible to sea turtles, the potential effects of research are expected to be minor. Table ES-8 presents potential effects of Status Quo/No Action on invertebrates.

Johnson's seagrass may be found in nearshore areas off the Florida coast where COASTSPAN surveys occasionally occur. Because the surveys are conducted using gillnets or longlines deployed from small boats or skiffs, and the gear is not dragged along the seafloor, the surveys may have a minor adverse effect on the species. NEFSC COASTSPAN surveys are not expected to affect designated Johnson's seagrass critical habitat.

TABLE ES-8. SUMMARY OF POTENTIAL IMPACTS OF THE STATUS QUO/NO ACTION ALTERNATIVE ON INVERTEBRATES

Invertebrate Species	Mortality from Surveys	Description
American lobster	Minor *adverse*	Research catch was only 0.03% of the total catch in 2017 (Table 4-20).
Northern shrimp	Moderate *adverse*	Spawning stock biomass in 2017 was estimated at 782 tons, well below the time series mean of 3,828 tons. NEFSC and cooperative research caught 0.5 tons of northern shrimp in 2017 (Table 4-20).
Horseshoe crab	Minor *adverse*	Research catch was only 0.05% of the total catch in 2017 (Table 4-20).

Effects on the Social and Economic Environment

Annual expenditures of the NEFSC for fisheries and ecosystem research have ranged from $60 - $70 million for the period 2016–2018. Both Status Quo and the Preferred Alternative would contribute important scientific information for sustainable fisheries management of the valuable commercial and recreational fisheries along the U.S. Atlantic Coast which generates billions of dollars' worth of sales, thousands of commercial fishing-related jobs, and provide millions of people across the country with highly valued seafood. While the contribution of research-related employment and purchased services is beneficial on an individual basis, the total contribution of research is very small when compared to the value of commercial and recreational fisheries in the communities. Fisheries research is considered a minor beneficial effect to the economic status of communities within the research areas.

Effects of the Preferred Alternative

The assessment of impacts of the Preferred Alternative (Alternative 2) would be similar to those of the Status Quo/ No Action Alternative. Additional assessment of impacts due to the use of additional or new surveys such as gearnet work and selectivity studies in small mesh fisheries and squid, conservation engineering projects such as scallop dredge finfish or hydrodynamic dredge development, or Autonomous Underwater Vehicle (AUV) pilot studies (see Section 2.2 for additional descriptions).

Effects on the Physical Environment

Potential effects on EFH, HAPC, closed areas, and the Stellwagen Bank and Monitor NMSs for this alternative would be expected to be the same as for the Status Quo/No Action Alternative.

Effects on Fish

The anticipated effects of NEFSC-affiliated fisheries research conducted under the Preferred Alternative would be the same as described for the Status Quo. The Preferred Alternative does not include any additional long-term surveys that would result in consequential increases in catch of any ESA-listed species, target species, HMS, or other fish species compared to Status Quo. Additional short-term cooperative research projects that anticipated to have a higher level of effort than Status Quo would occur cover large areas, involve minimal sampling, and do not target overfished species. For all target fish species, research catch is a very small percentage of the commercial ACL for each species by stock. In addition, the research catch is dispersed over a wide geographic area. Therefore, the effects of research catch on target fish species and HMS under the Preferred Alternative range from no effect to minor adverse, with the exception of the dusky shark, which would be moderate adverse.

Effects on Marine Mammals

Under the Preferred Alternative, the potential direct and indirect effects on marine mammals through M/SI, acoustic disturbance, or changes in prey availability would be similar to those described for the Status Quo Alternative (Section 4.3.2.2) and where effects have been identified, they would be considered minor adverse for all species. In addition to mitigation measures currently in place, minor modifications proposed by NEFSC (see Table 2-3) include reducing the pre-set watch time for trawling to 15 minutes (down from 30 minutes). Considering that (1) NEFSC has not had any takes for mortality or serious injury and (2) that acoustic (Level B) takes have been below authorized levels, the proposed mitigation measures as proposed under the Preferred Alternative are expected to continue to protect marine mammals.

Effects on Sea Turtles

Similar to Status Quo, the overall effects of the Preferred Alternative on ESA-listed sea turtles are considered minor in magnitude, dispersed over a large geographic area, and temporary or short-term in duration.

Effects on Invertebrates and Vegetation

The magnitude of mortality from NEFSC fisheries research on invertebrates is compared to the amount caught in commercial fisheries and is well below one percent of commercial landings for all major invertebrate species. As with Status Quo, because research mortality is very small relative to commercial fisheries, the potential effects of the Preferred Alternative are considered minor adverse on invertebrates, with the exception of Northern shrimp which would be moderate adverse. Effects on Johnson’s seagrass would be the same as Alternative 1: minor adverse.

Effects on the Social and Economic Environment

NEFSC-affiliated fisheries and ecosystem research conducted under the Preferred Alternative would provide a rigorous scientific basis for fisheries managers to set optimum yield fishery harvests while protecting the recovery of overfished resources and ultimately rebuilding these stocks to appropriate levels. Direct and indirect effects of the Preferred Alternative on the social and economic environment are anticipated to be minor to moderate in magnitude depending on the community, long-term, and would be widely dispersed throughout the Northeast region.

Cumulative Effects

Relevant past and present external actions and events that may interact with NEFSC fisheries and ecosystem research may include both human controlled activities (such as wind energy development, shipping or marine debris), and natural events (such as predation or climate change). Table 5-1 provides a list of past, present and RFFAs and natural events considered in the cumulative effects analysis in this SPEA.

Effects on the Physical Environment, Special Resource Areas, and EFH

The cumulative effects of proposed NEFSC fisheries and ecosystem research when combined with other past, present and future actions, would likely result in negligible cumulative effects on the physical environment. Likewise, NEFSC research would not contribute towards a cumulative effect on special resource areas or EFH within the research areas. While effects from actions external to NEFSC research (i.e., climate change) could be long-term, the magnitude of NEFSC research is not expected to alter habitat function or cause wide-spread changes to the geologic structure of the research areas (see Section 5.2.3).

Effects on Fish

Fisheries research has documented multiple stressors from single fishing types. The spatial scale of the cumulative effects of a single activity can vary across local and regional scales, as well as their duration and frequency over time. The consequences of these cumulative effects also depend on the condition (i.e., health) of the resource exposed. For example, an ESA-listed species would be more vulnerable to long-term consequences of cumulative effects than a non-listed species (see Section 5.2.4.1).

Climate change may have effects on weather patterns and sea surface temperature, which may shift the distribution of fish populations. Overall, the potential far-reaching impacts of climate change on fish habitat due to warming ocean temperatures, decreased habitat for selected species, changing distributions and abundance, changes in productivity and subsequent production, far exceed the minor impacts of fish removal as a result of NEFSC fisheries research.

Overall, the contribution of NEFSC research on fish is negligible and could be considered positive when considering overall benefits from new information gained through research (see Section 4.3.3.1).

Effects on Marine Mammals

Numerous natural and anthropogenic threats to marine mammals in the NEFSC research areas may affect their continued existence. These threats include oceanic and climatic regime shifts, habitat degradation, fisheries interactions, vessel strikes, and disease and other disturbances associated with human activities such as those described in Table 5-5. Collisions between ships and marine mammals, particularly large

whales, are increasing worldwide (Schoeman *et al.* 2020). In particular, ship strike mortality is a significant threat the endangered North Atlantic right whales. Between 1999 and 2018 a total of 57 confirmed right whale vessel collisions were documented as U.S. events or first detected in U.S. waters (NOAA 2020). The most likely impact of climate change on cetaceans could be changes in the area these species currently occupy due to changes in distribution of prey species with particular thermal requirements (81 FR 62259).

The cumulative effects from all past and present factors on ESA-listed and non-listed marine mammal species have, by definition, major impacts on the populations of these species. However, when considered in conjunction with other past, present, and reasonably foreseeable future activities affecting marine mammals in the NE LME, the contribution of the Status Quo or Preferred Alternative to cumulative effects on marine mammals would be minor and adverse through incidental take. However, fisheries and ecosystem research conducted by the NEFSC also provides valuable information for the conservation and management of ESA-listed and non-listed marine mammal species and this contribution to cumulative effects would be beneficial for these species (see Section 4.3.3.1).

Effects on Seabirds

Disturbances from human activities or natural events such as those listed in Table 5-6 can result in a reduction in seabird population health due to mortality, breeding failure or colony abandonment. As reported in (Webb and Kench 2010), sea-level rise would likely lead to more frequent over-wash of nesting islands by waves, and eventually to complete inundation on many islands and atolls used by breeding seabirds. Wind turbines located offshore would pose a risk of collision for seabirds and may also create barriers to movement resulting in seabird displacement (Michel *et al.* 2007). However, eiders and scoters have been documented to avoid offshore wind projects in Denmark and Sweden, and this is assumed to be triggered by visual or auditory cues.

No seabirds have ever been caught incidentally in NEFSC fisheries surveys and changes in availability of seabird prey resulting from NEFSC research surveys are expected to be localized and insubstantial. The contribution of NEFSC research activities to seabird collisions with vessels and loss or injury of seabirds from interactions with marine debris are expected to be negligible.

Effects on Sea Turtles

Coastal development continues to remove habitat and increase artificial lighting along the coastline which can alter turtle behavior (NMFS and USFWS 2013b, a). Sea turtles are also threatened by global climate change (Hawkes *et al.* 2007, Fuentes *et al.* 2011). Sea turtles with high fecundity and low juvenile survival are the most vulnerable to climate change and elevated levels of environmental variability (Cavallo *et al.* 2015). Sea turtles are threatened by several natural and anthropogenic impacts including but not limited to those listed in Table 5-7.

A Sea Turtle Climate Vulnerability Assessment based on similar assessment for marine mammals by Lettrich *et al.* (2019) is in progress. Behavioral changes such as changes in foraging or avoidance of migration corridors due to offshore vessel traffic, renewable energy, or coastal construction projects could decrease turtle productivity of survival. Within the context of global changes and stressors on sea turtles, the contribution of NEFSC research to cumulative effects on sea turtle populations and their habitat is negligible.

Effects on Invertebrates

Marine invertebrates are susceptible to natural and anthropogenic effects including exploitation through commercial and recreational fishing, habitat degradation and disturbance, pollution, competition with invasive species, and climate change. Degradation of invertebrate habitat can occur as a result of commercial and recreational fisheries that involve gear coming into contact with the sea floor. NEFSC research surveys remove small numbers of invertebrates. Mortality resulting from NEFSC fisheries research would be a minor contribution under each of the research alternatives to adverse cumulative effects on invertebrates.

Effects on the Social and Economic Environment

Table 5-10 provides a list of activities that could contribute to cumulative effects on social and economic resources in the Northeast Region include construction, renewable energy such as wind farms, commercial and recreational fisheries, shipping, coastal development, oil extraction, other scientific research, military operations, climate change, and ocean acidification (see Table 5-10). Space-use conflicts are common to all types of offshore activities including commercial fisheries; recreational fishing and other recreational activities; alternative energy facilities including offshore wind shipping traffic; and navigation. Considering the high number of wind energy projects planned along the Atlantic coast (see Figure 5-1), impacts to social and economic resources and proposed wind projects will occur and will be both positive and negative. Overall, NEFSC research may contribute certain economic benefits to local communities through research-related expenditures; however, these effects are likely to be minor compared to other key factors that affect communities, economics and the global economy.

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1 INTRODUCTION AND PURPOSE AND NEED

1.1 Introduction

The United States (U.S.) government has jurisdiction over the living marine resources in waters of the Exclusive Economic Zone (EEZ), 3 to 200 nautical miles (nm) from the U.S. shoreline. Congress has enacted several statutes authorizing federal agencies to manage and protect living marine resources. The National Oceanic and Atmospheric Administration (NOAA) is responsible for protecting marine finfish and shellfish species and their habitats. Within NOAA, the National Marine Fisheries Service (NMFS) is responsible for conducting science-based management, conservation, and protection of living marine resources within the U.S. EEZ.

The Northeast Fisheries Science Center (NEFSC) based in Woods Hole, Massachusetts and within NMFS's Northeast Region, is one of six Regional Fisheries Science Centers (Centers) that direct and coordinate the collection of scientific information required for adequate resource protection and fisheries management. NEFSC conducts research in U.S. waters from the Canadian border south to Cape Hatteras, North Carolina and also conducts surveys on highly migratory species extending to Florida. The NEFSC research program must comply with several major statutes including: the Magnuson-Stevens Fishery Conservation and Management Act (MSA), the Marine Mammal Protection Act (MMPA), the Endangered Species Act (ESA), the Atlantic Coastal Fisheries Cooperative Management Act (ACA), and the Atlantic Striped Bass Conservation Act among others. Table 1-1 briefly summarizes these and other statutes and treaties applicable to this analysis, and the actions taken to address their requirements. It is not necessarily a complete listing of all statutes, orders, or regulations applicable to the proposed action and alternatives.

The MSA established eight Regional Fishery Management Councils, consisting of fishing industry representatives, fishers, scientists, government agency representatives, federal appointees, and others. The Councils provide resource users and managers the ability to participate in the fisheries management process through the development of Fishery Management Plans (FMPs) and management measures for the fisheries occurring within the EEZ. Three Regional Fishery Management councils (the New England Fishery Management Council [NEFMC], the Mid-Atlantic Fishery Management Council [MAFMC], and the South Atlantic Fishery Management Council [SAFMC]) rely on data collected by the NEFSC. The NEFMC is responsible for federal waters off the shores of New York, New Jersey, Philadelphia, Delaware, Maryland, Virginia, and North Carolina; and SAFMC's management responsibilities includes federal waters off of South Carolina, Georgia, and part of Florida (Figure 1-1).

Other entities that coordinate with NEFSC to meet the requirements of these statutes for the Northeast Region include: the Greater Atlantic Regional Fisheries Office (GARFO); NMFS Headquarters; and the Atlantic States Marine Fisheries Commission (ASMFC). The ASMFC is one of three east coast Interstate Marine Fisheries Commissions chartered by Congress in 1942 (see Figure 1-1). It was formed by the 15 Atlantic coast states and coordinates the conservation and management of nearshore fishery resources shared by member states. For species that are fished in both state and federal waters the ASMFC works with the NEFMC, MAFMC, and SAFMC to develop FMPs.

1.2 Scope of the NEPA Analysis

The NEFSC previously analyzed the potential environmental effects of fisheries and ecosystem research and in July 2016 published a Final Programmatic Environmental Assessment (PEA) for Fisheries Research Conducted and Funded by the Northeast Fisheries Science Center (NMFS 2016a). The 2016 PEA (NMFS 2016a), hereby incorporated by reference, was determined to be sufficient and a Finding of No Significant Impact (FONSI) was signed on August 3, 2016. Concurrent with the 2016 PEA, NEFSC applied to NMFS for regulations and a five-year Letter of Authorization (LOA) for the incidental taking of marine mammals pursuant to Section 101(a)(5)(A) of the MMPA (Appendices C and E of NMFS 2016a). NMFS published the final rule and LOA authorizing the Taking Marine Mammals Incidental to Northeast Fisheries Science Center Fisheries Research in August 2016 (80 Federal Register [FR] 53016).

The 2016 PEA provides baseline descriptions of the physical, biological and human environments and analyses of the potential consequences of alternative approaches to fisheries and ecosystem research (NMFS 2016b). While the 2016 PEA and final rule provide the analytical framework to evaluate future research activities, the intent of this Supplemental PEA (SPEA) is to evaluate potential direct, indirect and cumulative effects of new research or changes in research that have occurred over the last 5 years which were not analyzed in the 2016 PEA. This Final SPEA includes the latest available information on proposed research activities planned for the period 2021–2026 and tiers from the original 2016 PEA to focus "… on the issues which are ripe for decision…[excluding] from consideration issues already decided or not yet ripe" (40 CFR 15020.28). Where necessary, updates to certain information on species, stock status or other components of the affected environment that may result in different conclusions from the 2016 PEA are presented in this analysis.

This SPEA also provides a basis for compliance with other statutes including the MMPA, ESA, National Marine Sanctuaries Act (NMSA), National Historic Preservation Act (NHPA), Coastal Zone Management Act (CZMA), Executive Order (EO) 12114 for Environmental Justice, Migratory Bird Treaty Act (MBTA), and Essential Fish Habitat (EFH)/MSA, as well as to support consultation with native tribes within the Action Area. These are summarized in Table 1-1.

1.3 Purpose and Need

The federal action to be analyzed under this SPEA is the proposed continuation of NEFSC fisheries research activities. The purpose of NEFSC fisheries research is to produce scientific information necessary for the management and conservation of living marine resources in the NMFS Northeast Region. NEFSC's research is needed to promote both the long-term sustainability of the resource and the recovery of certain species, while generating social and economic opportunities and benefits from their use. Each of the research activities requires specific authorizations or permits including an authorization under the MMPA. The issuance of permits and the MMPA authorization are components of the federal action covered under this supplemental NEPA review.

TABLE 1-1. COMPLIANCE ACTIONS FOR APPLICABLE LAWS, REGULATIONS AND TREATIES

Law	Description	Action Taken	Date	Required SPEA Actions
National Environmental Policy Act (NEPA)	Requires federal agencies to evaluate potential environmental effects of any major planned federal action and promotes public awareness of potential impacts by requiring federal agencies to prepare an environmental evaluation for any major federal action affecting the human environment.	1) PEA 2) FONSI	1) 07/2016 2) 08/03/2016	1) NMFS approval of Draft SPEA 2) SPEA NOA 3) 30-day comment period 4) Final SPEA published 5) FONSI
Magnuson-Stevens Fishery Conservation and Management Act (MSA)	Authorizes the U.S. to manage fishery resources from a state's territorial sea or EEZ (3 nm to 200 nm from shore). Includes 10 national standards to promote domestic commercial and recreational fishing under sound conservation and management principles. Supports the preparation and implementation of FMPs.	1) EFH Request for concurrence sent to GARFO 2) GARFO provided comments and suggestions 3) GARFO provides concurrence memo	1) 05/20/2015 2) 08/14/2015 3) 11/16/2015	No additional consultation needed.
Marine Mammal Protection Act (MMPA)	Prohibits the take of marine mammals in U.S waters and by U.S. citizens on the high seas and the importation of marine mammals and marine mammal products into the U.S. Allows, upon request, the "incidental," but not intentional, taking of small numbers of marine mammals.	1) LOA application 2) Proposed rule published 3) Proposed rule corrected 4) Proposed rule corrected 5) Final rule published	1) 12/17/2014 2) 07/09/2015 3) 08/06/2015 4) 08/17/2015 5) 08/11/2016	1) LOA application NOR 2) Proposed rule published 3) 30-day comment period 4) Final rule published 5) 30 day wait period for final rule 6) LOA issued

Law	Description	Action Taken	Date	Required SPEA Actions
Endangered Species Act (ESA)	Provides for the conservation and recovery of endangered and threatened species of fish, wildlife, and plants. Prohibits the take of endangered species and some threatened species with some exceptions and exemptions. Administered jointly by NMFS and the USFWS.	1) Request formal consultation with GARFO 2) GARFO determines request is complete 3) Consultation put on hold due to sperm whale take revisions 4) NMFS BiOp and Incidental Take Statement	1. 05/08/2015 2. 07/09/2015 3. 08/27/2015 4. 07/23/2016	1) Draft Biological Assessment (BA) 2) Final BA 3) Consultation with ESA Division 4) Draft BiOp and Incidental Take Authorization (ITA) 5) Final BiOp
Migratory Bird Treaty Act (MBTA)	Protects approximately 836 species of migratory birds from any attempt at hunting, pursuing, wounding, killing, possessing, or transporting any migratory bird, nest, egg, or part thereof, unless permitted by regulations.	Draft PEA sent to the USFWS. No comments received concerning compliance with the MBTA.		SPEA published for comment. No additional documentation required.
Fish and Wildlife Coordination Act (FWCA)	Requires USFWS and NMFS to consult with other state and federal agencies in a broad range of situations to help conserve fish and wildlife populations and habitats in cases where federal actions affect natural water bodies.	Draft PEA sent to the state fish and wildlife agencies in every state affected by the NEFSC fisheries research activities. No comments concerning compliance with the FWCA were received.		SPEA transmitted to agencies. No additional documentation required.

Law	Description	Action Taken	Date	Required SPEA Actions
National Marine Sanctuaries Act (NMSA)	Authorizes the Secretary of Commerce to designate and protect areas of the marine environment with special national significance due to their conservation, recreational, ecological, historical, scientific, cultural, archeological, educational, or esthetic qualities as national marine sanctuaries. Section 304(d) of the NMSA requires interagency consultation between the NOAA Office of National Marine Sanctuaries (ONMS) and federal agencies taking actions that are "likely to destroy, cause the loss of, or injure a sanctuary resource."	1) Request for consultation sent to ONMS, Gray's Reef NMS, Monitor NMS, and Stellwagen Bank NMS 2) ONMS responded with comments 3) NEFSC provided additional information and permit request for activities in Stellwagen Bank NMS 4) Permit SBNMS-2015-003 issued for work in Stellwagen Bank NMS	1) 08/04/2015 2) 09/23/2015 3) 11/16/2015 4) 04/01/2016	SPEA sent to ONMS for comment. No additional consultation under Section 304(d) required. Letter from M. Brookhart dated September 18, 2020 acknowledged that consultation under section 304(d) of the NMSA has been completed.
National Historic Preservation Act (NHPA)	Section 106 requires review of any project funded, licensed, permitted, or assisted by the federal government for impact on significant historic properties.	NEFSC initiated consultation with Maine, Maryland, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York Virginia, North Carolina Historic Preservation Offices.	08/04/2015	SPEA published for comment. No additional documentation required.
Executive Order (EO) 12989, Environmental Justice	Directs federal agencies to identify and address disproportionately high and adverse effects of federal projects on the health or environment of minority and low-income populations to the greatest extent practicable and permitted by law.	PEA prepared in accordance with EO		No action required.

Law	Description	Action Taken	Date	Required SPEA Actions
Executive Order 13158, Marine Protected Areas	Strengthened and expanded the Nation's system of MPAs and encourages federal agencies to use science-based criteria and protocols to identify and prioritize natural and cultural resources in the marine environment that should be protected to secure valuable ecological services and to monitor and evaluate the effectiveness of MPAs. Each federal agency whose actions affect the natural or cultural resources that are protected by an MPA shall identify such actions. To the extent permitted by law and to the maximum extent practicable, each federal agency, in taking such actions, shall avoid harm to the natural and cultural resources that are protected by an MPA.	PEA prepared in accordance with EO		MPAs are evaluated in the SPEA.
Coastal Zone Management Act (CZMA)	Encourages and assists states in developing coastal management programs. Requires any federal activity affecting the land or water use or natural resources of a state's coastal zone to be consistent with that state's approved coastal management program.	NMFS provided a copy of the Final PEA to the coastal management agency in every state with a federally-approved coastal management program whose coastal uses or resources are affected by these fisheries research activities		SPEA sent to coastal management agencies. No additional documentation required.

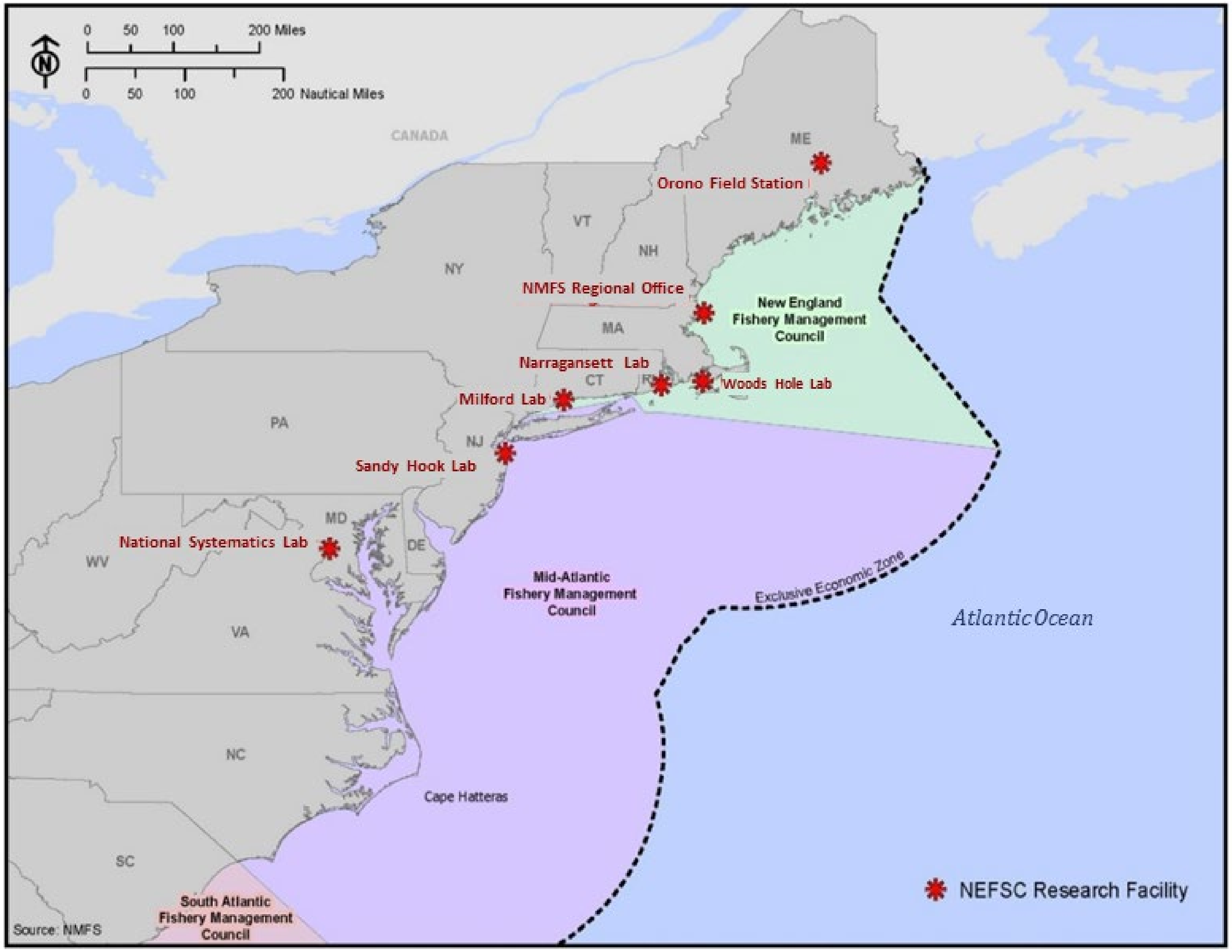


FIGURE 1-1. APPLICABLE FISHERIES MANAGEMENT COUNCIL BOUNDARIES AND NEFSC RESEARCH FACILITIES

1.4 Project Area

The Project Area is defined as the area within which all direct and indirect effects of the Project may occur. The NEFSC conducts research and provides scientific advice to manage fisheries and conserve protected species in three areas that comprise the Project Area along the Atlantic coast of the U.S., primarily within 200 miles of the shoreline from Cape Hatteras, North Carolina to the U.S.- Canada border. This primary research area is known as the Northeast U.S. Continental Shelf Large Marine Ecosystem (NE LME). In addition, a small number of NEFSC survey activities extend south into the Southeast U.S. Continental Shelf LME and north into the Scotian Shelf LME. However, the majority of NEFSC research activities occur within the NE LME (see Figure 1-1).

1.5 Public Review and Comment

Federal agencies must involve agencies, applicants, and the public in the NEPA process (40 CFR Sec. 1501.4 [b]). Guidance for the public review process for the 2016 PEA and this SPEA is provided in in Section 7B of *Policy and Procedures for Compliance with the National Environmental Policy Act - Companion Manual for NOAA Administrative Order (NAO) 216-6A* (NOAA 2017). A notice of availability (NOA) for the original Draft PEA and the associated LOA application was published in the Federal Register on December 29, 2014 (79 FR 78061), and the documents were made available on the internet. Comment letters raising substantive issues were received from the Marine Mammal Commission and in a joint letter from the Humane Society of the U.S. and Whale and Dolphin Commission. A letter from the Virginia Department of Environmental Quality and the Virginia Marine Resources Commission did not find any issues with the structure or analysis provided in the Draft PEA. The NOA for the proposed MMPA regulations was published in the Federal Register on July 9, 2015 (80 FR 39542). Additional information regarding public review and detailed responses to comments are provided in Section 1.5 of the PEA (NMFS 2016a).

A Notice of Availability (NOA) for draft SPEA (NMFS 2020c) was published in the Federal Register on September 18, 2020 (85 FR 58339). The public comment period closed on October 19, 2020. One comment letters was received. The Virginia Department of Environmental quality had no concerns with the Draft SPEA. NOAA approved changes to Virginia's Coastal Zone Management (CZM) program on October 2, 2020[1].

Following release of the Final SPEA, NMFS will make its decision concerning the Preferred Alternative for NEFSC research. NMFS will issue the Record of Decision approximately one month after the Final SPEA is released to the public. This decision document will conclude the NEPA process on the proposed action.

[1] https://www.deq.virginia.gov/home/showpublisheddocument?id=4046, https://www.deq.virginia.gov/home/showpublisheddocument?id=4048

2 DESCRIPTION OF ALTERNATIVES

The 2016 PEA (NMFS 2016a) evaluated four alternatives for fisheries research ranging from no action to a full suite of research activities and mitigation measures. The 2016 PEA Preferred Alternative (referred to in the 2016 PEA as Alternative 2) was based on a level of fisheries survey effort from 2008-2012 and has provided the framework under which fisheries research has been conducted since 2016. In Section 2.6, the 2016 PEA describes three alternatives that were considered, but were determined to not meet the purpose and need and were not brought forward for analysis. This action is supplemental to the original evaluation in 2016; therefore, alternatives dismissed previously are not considered further for the same reasons explained in the 2016 PEA.

The range of alternatives evaluated in this SPEA presents the status quo/no action (i.e., current research) as Alternative 1 while Alternative 2 presents modifications to current research or new research activities that are planned for the future (i.e., 2021–2026). New future research proposed under Alternative 2 was not previously analyzed in the 2016 PEA. Table 2-1 provides a brief summary of research surveys by type or gear as a simple comparison of alternatives. Table 2-2 provides a more detailed description of each survey proposed under the alternatives including survey description, area of operation, specific gears proposed, number of estimated days-at-sea (DAS), and number of sampling tows. A description of typical vessels and gear used during NEFSC surveys is provided as Appendix A. Appendix A is not intended to be a comprehensive or specific list, rather, the gear and vessels described would be the same or very similar to those used during research such that any potential effects of their use would be commensurate to the evaluation presented in this SPEA.

TABLE 2-1. SUMMARY OF RESEARCH BY ALTERNATIVE WITH PROPOSED FUTURE SURVEYS SHOWN IN BOLD ITALICS (ALTERNATIVE 2)

Survey Using Gear Type	Alternative 1 *No Action,* Status Quo	Alternative 2[1] *Preferred Alternative* Future Research
Bottom Trawl Gear	• Benthic Habitat Survey • Northeast Area Monitoring and Assessment Program (NEAMAP) • Standard Bottom Trawl Surveys • Habitat Mapping Survey • State Trawl Fisheries • Northern Shrimp Survey • Northeast Fisheries Observer Program (NEFOP) • NEFSC Trawl Comparison Research and Standardization	**Same as Alt. 1 plus**: • Community Structure Study[2] • Marine Resources Survey[2] • Herring Survey[2] • ***Fish Collection*** • ***Flatfish Surveys*** • ***Conservation Engineering Projects***[3] • ***Tagging Projects***[4]
Pelagic Trawl Gear	• Penobscot Maine Estuarine & Ecosystem Survey • Deepwater Biodiversity Survey	**Same as Alt. 1 plus**: • ***Atlantic Herring Survey*** • ***Atlantic Salmon Survey*** • ***Northeast Integrated Pelagic Mid-water Trawls*** • ***Catchability Surveys***[5] • ***NEFOP Mid-water Trawl Observer Training***
Longline Surveys	• Apex Predators Bottom Longline Coastal Shark Survey • Apex Predators Pelagic Nursery Grounds Shark Survey • COASTSPAN Longline and Gill net Surveys[6] • Cooperative Longline Projects[7]	**Same as Alt. 1 plus:** • ***Apex Predators Pelagic Longline Shark Survey*** • ***NEFOP Bottom Longline Observer Training***
Dredge Surveys	• Annual Standard Sea Scallop Survey • Scallop Closed Area Survey[8] • Research Set-Aside Scallop Surveys • Surfclam & Quahog Surveys • NEFOP Scallop Dredge Survey Observer Training	**Same as Alt. 1 plus:** • ***Conservation Engineering Project***[9]

Survey Using Gear Type	Alternative 1 *No Action, Status Quo*	Alternative 2[1] *Preferred Alternative* Future Research
Other Gear and Survey Type	• Coastal Maine Telemetry Network • Deep Sea Coral Survey • Diving Operations • Gulf of Maine Ocean Observing System Mooring Cruise • NEFOP Gillnet Observer Training • Rotary Screw Trap Survey • Research Set-Aside Gillnet Monkfish Surveys • Continuous Plankton Recorder Transect Surveys Gulf of Maine[10]	**Same as Alt 1. Plus:** • ***Maine Estuaries Diadromous Survey*** • ***Nutrients and Frontal Boundaries*** • ***Ocean Acidification*** • ***Autonomous Underwater Vehicle (AUV) Pilot Studies*** • ***Finfish Aquaculture Trawling*** • ***Delaware-Maryland-Virginia (DelMarVa) Habitat Characterization*** • ***DelMarVa Reefs Survey*** • ***Fish Collection*** • ***Opportunistic Hydrographic Sampling*** • ***Tagging Projects (Gillnets, Hook & Line, Rod and Reel)*** • ***Passive Acoustic Monitoring*** • ***Trap and pot conservation engineering (Protected Species – rope- less trap lines)***[11] • ***Surveys Using Pots & Traps***[12]

[1] Proposed activities that did not occur over the period 2016–2018 are shown in bold italics. There was a significant reduction in research during 2016–2018 due to several factors including reduced funding. The 2016 PEA analyzed a wide range of research, some of which was not fully funded or conducted. Those projects are now listed under Alternative 2 for future research (see Section 2.2).
[2] Status Quo projects that were never fully funded in the past and never conducted but may occur under the Preferred Alternative.
[3] Such as trawl gear work and selectivity studies in small mesh fisheries and squid.
[4] Winter flounder migration patterns.
[5] Monkfish, longfin squid and other species.
[6] Also uses gillnets.
[7] Such as Western Central Gulf of Maine hard bottom longline survey.
[8] Scallop abundance and distribution.
[9] Such as scallop dredge finfish and turtle excluder devices, and hydrodynamic dredge development.
[10] Monthly CPR transects from Maine to Nova Scotia
[11] Ropeless lobster pot float lines (acoustic release devices) for protected species research.
[12] Such as scup and black sea bass pot surveys.

TABLE 2-2. DETAILED DESCRIPTION OF ALTERNATIVES BY SURVEY

Alternative(s)	Project Name	Survey Description	Main Gear Type	Specific Gear	Area of Operation	Annual Days at Sea (DAS)
Long-Term Research						
1 and 2	**Benthic Habitat Survey**	The objective of this project is to assess habitat distribution and condition, including disturbance by commercial fishing and changes as the benthic ecosystem recovers from chronic fishing impacts. Also serves to collect data on seasonal migration of benthic species, collect bottom data for mapping, and provide indications of climate change through species shifts.	Bottom Trawl	Conductivity, Temperature, and Depth (CTD), Van Veen, Plankton trap, Beam Trawl, Dredge, Camera, Sonar	Georges Bank (GB)	20
2 only	**Fish Collection for Laboratory Experiments**	Trawling/hook and line collection operations undertake to capture high quality fish for laboratory experiments.	Bottom Trawl	Net and twine shrimp trawl, fishing poles	New York Bight, Sandy Hook Bay	10
1 and 2	**Habitat Mapping Survey**	This project maps shallow reef habitats of fisheries resource species, including warm season habitats of black sea bass, and locate sensitive habitats (e.g. shallow temperate coral habitats) for habitat conservation.	Bottom Trawl	4-seam, 3 bridle bottom trawl, beam trawl, CTD, Van Veen, Plankton trap, dredge, camera, sonar	Ocean Shelf off Maryland	11
2 only	**Living Marine Resources Survey**	This project undertakes to determine the distribution, abundance, and recruitment patterns for multiple species.	Bottom Trawl	4-seam, 3 bridle bottom trawl, beam trawl, CTD, Van Veen, sonar	Cape Hatteras to New Jersey	11
1 and 2	**Massachusetts Division of Marine Fisheries Bottom Trawl Surveys**	The objective of this project is to track mature animals and determine juvenile abundance.	Bottom Trawl	Otter trawl	Territorial waters from Rhode Island to New Hampshire borders	60–72

Alternative(s)	Project Name	Survey Description	Main Gear Type	Specific Gear	Area of Operation	Annual Days at Sea (DAS)
1 and 2	**NEAMAP Near Shore Trawl Program - Northern Segment**	This project provides data collection and analysis in support of single and multispecies stock assessments Gulf of Maine. It includes the Maine/New Hampshire inshore trawl program, conducted by Maine Department of Marine Resources (MDMR) in the northern segment.	Bottom Trawl	Modified Gulf of Maine (GOM) shrimp otter trawl net	U.S.-Canada border to New Hampshire-Massachusetts border from shore to 300 ft depth	30-50
1 and 2	**NEAMAP Near Shore Trawl Program - Southern Segment**	This project provides data collection and analysis in support of single and multispecies stock assessments in the Mid-Atlantic. It includes the inshore trawl program NEAMAP Mid-Atlantic to Southern New England survey, conducted by Virginia Institute of Marine Science, College of William and Mary (VIMS) in the southern segment.	Bottom Trawl	4-seam, 3-bridle net bottom trawl cookie sweep	Montauk, New York to Cape Hatteras, North. Carolina from 20 to 90 ft depth	30-50
1 and 2	**NEFOP) Observer Bottom Trawl Training Trips**	The objective of this project is fish and invertebrate sampling for biometric and population analysis of estuarine and coastal species.	Bottom Trawl	Contracted vessels' trawl gear	Maine to North Carolina	18
1 and 2	**NEFSC Northern Shrimp Survey**	The objective of this project is to determine the distribution and abundance of northern shrimp and collect related data.	Bottom Trawl	4 seam modified commercial shrimp trawl, positional sensors, mini-log, CTD	GOM	22
1 and 2	**NEFSC Standard Bottom Trawl Surveys (BTS)**	This project monitors abundance and distribution of mature and juvenile fish and invertebrates.	Bottom Trawl	4-seam, 3-bridle bottom trawl	Cape Hatteras to Western Scotian Shelf	120
1 and 2	**NEFSC Bottom Trawl Survey Gear Trials**	Testing and efficiency evaluation of the standardized 4-seam, 3-bridle bottom trawl (doors, sweeps, protocols).	Bottom Trawl	4-seam, 3-bridle bottom trawl, twin trawls	Cape Hatteras to Western Scotian Shelf	14–20

Alternative(s)	Project Name	Survey Description	Main Gear Type	Specific Gear	Area of Operation	Annual Days at Sea (DAS)
2 only	**Atlantic Herring Survey**	This operation collects fisheries-independent herring spawning biomass data and also includes survey equipment calibration and performance tests.	Pelagic Trawl	4-seam, 3-bridle net bottom trawl, midwater rope trawl, acoustics	GOM and Northern GB	34
2 only	**Atlantic Salmon Trawl Survey**	This is a targeted research effort to evaluate the marine ecology of Atlantic salmon.	Pelagic Trawl	Modified mid-water trawl that fishes at the surface via pair trawling	Inshore and offshore GOM	21
1 and 2	**Deepwater Biodiversity**	This project collects fish, cephalopod and crustacean specimens from 500 to 2000 m for tissue samples, specimen photos, and documentation of systematic characterization.	Pelagic Trawl	Deep-Sea acoustic/optic/oceanographic/eDNA system, trawl camera system	Western North Atlantic	16
1 and 2	**Penobscot Estuarine Fish Community and Ecosystem Survey**	The objective of this project is fish and invertebrate sampling for biometric and population analysis of estuarine and coastal species.	Pelagic Trawl	Mamou shrimp trawl modified to fish at surface	Penobscot Estuary and Bay, Maine	12
2 only	**Northeast Integrated Pelagic Survey**	The objective of this project is to assess the pelagic components of the ecosystem including water currents, water properties, phytoplankton, micro-zooplankton, mesozooplankton, pelagic fish and invertebrates, sea turtles, marine mammals, and sea birds.	Pelagic Trawl	Mid-water trawls, bong nets, CTD, Acoustic Doppler Profiler (ADCP), acoustics	Cape Hatteras to Western Scotian Shelf	80
2 only	**NEFOP Observer Mid-Water Trawl Training Trip**	This program provides certification training for NEFOP Observers.	Pelagic Trawl	Various commercial nets	Maine to North Carolina	5

Alternative(s)	Project Name	Survey Description	Main Gear Type	Specific Gear	Area of Operation	Annual Days at Sea (DAS)
2 only	**Apex Predators Pelagic Longline Shark Survey**	The objectives of this survey are to: 1) monitor the species composition, distribution, and abundance of pelagic sharks in the U.S. Atlantic from Maryland to Canada; 2) tag sharks for migration and age validation studies; 3) collect morphological data and biological samples for age and growth, feeding ecology, and reproductive studies; and 4) provide time-series of abundance from this survey for use in Atlantic pelagic shark assessments.	Longline	Yankee and current commercial pelagic longline gear. Configured according to NMFS Highly Migratory Species (HMS) Regulations	Maryland to Canada	30
1 and 2	**Apex Predators Bottom Longline Coastal Shark Survey**	The objectives of this survey are to: 1) monitor the species composition, distribution, and abundance of sharks in coastal Atlantic waters from Florida to Delaware; 2) tag sharks for migration and age validation studies; 3) collect morphometric data and biological samples for age and growth, feeding ecology, and reproductive studies; and 4) provide time-series of abundance from this survey for use in Atlantic coastal shark assessments.	Longline	Florida style bottom longline	Rhode Island south. Does not go south of Cape Hatteras; within 40 fathoms	47
1 and 2	**Apex Predators Pelagic Nursery Grounds Study**	This project uses opportunistic sampling on board a commercial swordfish longline vessel to: 1) monitor the species composition and distribution of juvenile pelagic sharks on the Grand Banks; 2) tag sharks for migration and age validation studies; and 3) collect morphometric data and biological samples for age and growth, feeding ecology, and reproductive studies. Data from this survey helps determine the location of pelagic shark nurseries for use in updating essential fish habitat designations.	Longline	Standard commercial pelagic longline gear. Configured according to NMFS Highly Migratory Species (HMS) Regulations	GB to Grand Banks off Newfoundland, Canada	21-55

Alternative(s)	Project Name	Survey Description	Main Gear Type	Specific Gear	Area of Operation	Annual Days at Sea (DAS)
1 and 2	**Cooperative Atlantic States Shark Pupping and Nursery (COASTSPAN) Longline and Gillnet Surveys**	This project determines the location of shark nurseries, species composition, relative abundance, distribution, and migration patterns. It is used to identify and refine essential fish habitat and provides standardized indices of abundance by species used in multiple species specific stock assessments. NEFSC conducts surveys in Delaware, New Jersey, and Rhode Island estuarine and coastal waters. Other areas are surveyed by cooperating institutions and agencies. In the NE LME, the Virginia Institute of Marine Science (VIMS) is a cooperating partner.	Longline and Gillnet	Bottom Longline Gear, Anchored Sinking Gillnet	Florida to Rhode Island	25 or 40
1 and 2	**Cooperative Research Gulf of Maine Longline Project**	The objective of this project is to conduct commercial cooperative bottom longline sets to characterize demersal species of the Western Gulf of Maine traditionally difficult to capture with traditional or research trawl gear due to the bottom topography.	COOP Western-Central Gulf of Maine hard bottom longline survey	Longline	Western Gulf of Maine	60 longline stations per year in eastern Maine, 90 longline stations per year in western-central GOM
2 only	**NEFOP Observer Bottom Longline Training Trips**	This program provides certification training for NEFOP observers.	Longline	Commercial bottom longline gear	Maine to North Carolina	5
1 and 2	**Annual Assessments of Sea Scallop Abundance and Distribution**	These Atlantic Sea Scallop Research Set-Aside (RSA) rotational area surveys endeavor to monitor scallop biomass and derive estimates of Total Allowable Catch (TAC) for annual scallop catch specifications. Additionally, the surveys monitor recruitment, growth, and other biological parameters such as meat weight, shell height and gonadal somatic indices.	Dredge	Scallop dredges, drop cameras, Other Habitat Camera (HabCam) Versions	Gulf of Maine, Georges Bank, Mid-Atlantic	50 - 100

Alternative(s)	Project Name	Survey Description	Main Gear Type	Specific Gear	Area of Operation	Annual Days at Sea (DAS)
1 and 2	**NEFOP Observer Scallop Dredge Training Trips**	This program provides certification training for NEFOP observers.	Dredge	Turtle deflector dredge	Maine to North Carolina	6
1 and 2	**Annual Standardized Sea Scallop Survey**	The objective of this project is to determine distribution and abundance of sea scallops and collect related data for Ecosystem Management from concurrent stereo-optic images. It is conducted by the NEFSC.	Dredge	New Bedford dredge, HabCam V4	North Carolina to GB	36
1 and 2	**Surfclam and Ocean Quahog Dredge Survey**	The objective of this project is to determine distribution and abundance of Surfclam/ocean quahog and collect related data.	Dredge	Hydraulic-jet dredge	Southern Virginia to GB	15
1 and 2	**Coastal Maine Telemetry Network**	The objective of this project is to monitor tagged animals entering the Penobscot Bay System and exiting the system into the Gulf of Maine.	Other	Fixed position acoustic telemetry array receivers on moorings spaced 250-400 m apart	Penobscot River, estuary and bay, GOM	10
1 and 2	**Deep-sea Coral Survey**	The objective of this program is to determine the species diversity, community composition, distribution and extent of deep sea coral and sponge habitats.	Other	ROV, CTD, towed cameras, ADCP, acoustics	Continental shelf margin, slope, and submarine canyons and deep basins: GOM to Virginia	16
1 and 2	**Diving Operations**	The objective of this project is to collect growth data on hard clams, oysters and bay scallops.	Other	Wire mesh cages, lantern nets	Long Island Sound	20
1 and 2	**Gulf of Maine Ocean Observing System Mooring Cruise**	This project services oceanographic moorings operated by the University of Maine.	Other	ADCP on vessel and moorings	GOM and Northern GB	12

Alternative(s)	Project Name	Survey Description	Main Gear Type	Specific Gear	Area of Operation	Annual Days at Sea (DAS)
2 only	**Hydroacoustics Surveys**	This project consists of mobile transects conducted throughout the estuary and bay to study fish biomass and distribution.	Acoustic only	Split-beam and DIDSON	Penobscot Bay and estuary	25
2 only	**Marine Estuaries Diadromous Survey**	This project is a fish community survey at fixed locations.	Other	1 m and 2 m fyke nets	Penobscot Bay and estuary	100
1 and 2	**NEFOP Observer Gillnet Training Trips**	This program provides certification training for NEFOP Observers.	Other	gill net gear	Maine to North Carolina	10
2 only	**Nutrients and Frontal Boundaries**	The objective of this project is to characterize nutrient patterns associated with distinct water masses and their boundaries off of coastal New Jersey and Long Island in association with biological sampling.	Other	ADP, CTD, Hydroacoustics	MAB	10
2 only	**Ocean Acidification**	The objective of this project is to develop baseline pH measurements in the Hudson River water.	Other	CTD, YSI, multi-nutrient analyzer, Kemmerer bottle	Hudson River Coastal waters	10
2 only	**AUV Pilot Studies**	This program provides gear and platform testing.	Other	AUV	Massachusetts state waters, GB	5
1 and 2	**Rotary Screw Trap (RSTs) Survey**	This project is designed to collect abundance estimates of Migrating Atlantic salmon smolts and other anadromous species.	Other	RST	Estuaries on coastal Maine rivers	60
2 only	**Trawling to Support Finfish Aquaculture Research**	The objective of this project is to collect broodstock for laboratory spawning and rearing and experimental studies.	Other	Combination bottom trawl, shrimp trawl, gillnet	Long Island Sound	30

Alternative(s)	Project Name	Survey Description	Main Gear Type	Specific Gear	Area of Operation	Annual Days at Sea (DAS)
2 only	**DelMarVa Habitat Characterization**	The objective of this project is to characterize and determine key hard bottom habitats in coastal ocean off the DelMarVa Peninsula as an adjunct to the DelMarVa Reef Survey.	Other	ADCP, CTD, YSI, Plankton net, video sled, Ponar grab, Kemmerer bottle, sonar	Coastal waters off DE, MD and VA	5
2 only	**DelMarVa Reefs Survey**	The objective of this project is determination of extent and distribution of rock outcrops and coral habitats and their use by black sea bass and other reef fishes	Other	HABCAM, CTD	Coastal waters off DE, MD and VA	5
2 only	**Miscellaneous Fish Collections and Experimental Survey Gear Trials**	The James J. Howard Sandy Hook Marine Laboratory occasionally supports short-term research projects requiring small samples of fish for various purposes or to test alterations of survey gear. These small and sometimes opportunistic sampling efforts have used a variety of gear types other than those listed under Status Quo projects. The gears and effort levels listed here are representative of potential requests for future research support.	Other	Bottom trawl, lobster and fish pots, beam trawl, seine net, trammel nets	New York Bight estuary waters	not stated
2 only	**Opportunistic Hydrographic Sampling**	This program consists of opportunistic plankton and hydrographic sampling during ship transit.	Other	Plankton net, expendable bathythermograp hs	Southeast LME at depths less than 300 m	not stated
1 and 2	**Monkfish RSA**	Monkfish RSA surveys endeavor to monitor Monkfish biomass and derive estimates of Total Allowable Catch (TAC) for annual Monkfish catch specifications. Additionally, the surveys monitor recruitment, growth, and other biological parameters.	Other	Commercial Gill nets of various sizes, short durations for sets.	Mid-Atlantic and Georges Bank	100–200 sets per year. Sets left for 2–3 days.

Alternative(s)	Project Name	Survey Description	Main Gear Type	Specific Gear	Area of Operation	Annual Days at Sea (DAS)
Short-Term Projects						
2 only	**Survey Projects**	Cooperative Industry based surveys to enhance data for flatfish utilizing cookie sweep gear on commercial platforms.	Flatfish Surveys	Bottom Trawl	GOM, GB, SNE, MAB	550 tows per year
2 only	**Survey Projects**	Cooperative Industry based catchability studies for Monkfish, Longfin squid, other.	Monkfish, longfin squid and other catchability surveys	Pelagic Trawl	GOM, GB, SNE, MAB	30 tows per year
2 only	**Trawl Comparison Research**	Twin trawl and paired vessel comparisons of Standardized Bigelow Trawl to test rockhopper and cookie sweeps and varying trawl doors performance on commercial platforms.	Sweep Comparison of Bigelow trawl nets with two types of sweeps or doors	Twin Bottom Trawl	GB, SNE, MAB	100
2 only	**Survey Projects**	Pot and trap catchability studies for Scup and Black Sea bass.	Scup & black sea bass pot survey	Pots and Traps	SNE, Rhode Island Bight, Nantucket Sound, MAB waters from shore to shelf edge.	2650 pot sets per year
2 only	**Conservation Engineering Projects**	Gear and net conservation Cooperative work.	Gearnet conservation work	Bottom Trawl	GOM, GB, SNE, MAB	Est. 500 tows per year total for all bottom trawl conservation projects
2 only	**Conservation Engineering Projects**	Varied gear and efficiency testing of fisheries applications.	Selectivity studies in Acadian redfish fishery and other Small mesh fisheries	Bottom Trawl	GOM, GB, SNE, MAB	Est. 500 tows per year total for all bottom trawl conservation projects

Alternative(s)	Project Name	Survey Description	Main Gear Type	Specific Gear	Area of Operation	Annual Days at Sea (DAS)
2 only	**Conservation Engineering Projects**	Cooperative Squid Trawls and studies for squid catchability and selectivity.	Squid selectivity studies	Bottom Trawl & Beam trawl	GOM, GB, SNE, MAB	Est. 500 tows per year total for all bottom trawl conservation projects
2 only	**Conservation Engineering Projects**	Commercial scallop dredge finfish and turtle excluder research.	Scallop dredge finfish and turtle excluder research	Dredge	GB, SNE, MAB	Est. over 1,700 dredge tows per year for all dredge conservation projects
2 only	**Conservation Engineering Projects**	Commercial hydrodynamic turtle deflector dredge testing.	Hydrodynamic dredge development	Dredge	GB, SNE, MAB	Est. over 1,700 dredge tows per year for all dredge conservation projects
2 only	**Tagging Projects**	Winter Flounder tagging projects.	Winter flounder migration patterns	Bottom Trawl & Otter trawl	Coastal waters in Gulf of Maine from New Hampshire to Stonington/Mt. Desert Island, Maine	up to 650 trawls per year
2 only	**Tagging Projects**	Spiny dogfish tagging projects.	Spiny dogfish tagging north and south of Cape Cod, and Cusk & NE multi-species tagging	Hook & Line and Gillnet	GOM and GB waters adjacent to Cape Cod, MA	Long line: 5 sets per trip, 15 sets total. Gillnet: 5 sets per trip, 15 sets total.

Alternative(s)	Project Name	Survey Description	Main Gear Type	Specific Gear	Area of Operation	Annual Days at Sea (DAS)
2 only	**Tagging Projects**	Monkfish tagging projects.	Monkfish tagging	Gillnet	GOM, SNE, MAB	18-20 DAS, 10 short-duration sets per day, 180-200 sets total
1 and 2	**Ropeless Lobster Trap Research**	Research to develop ropeless gear/devices to mitigate/eliminate interactions with protected species (whales and turtles) by utilizing commercial lobster gear.	Lobster Pots/Traps	Acoustic/mechanical releases for ropeless lobster gear and float lines	GOM, SNE, MAB (Inshore and Offshore)	50–100 DAS, estimated 500 sets, singles and up to 40 pots per set
2 only	**Rod and Reel Tagging of Atlantic Salmon**	Use of rod and reel to capture, tag, release Atlantic salmon in international and US waters	Rod and Reel	Acoustic tags	Maine, Greenland	200 - 500 tags applied per year
1 and 2	**Continuous Plankton Recording Transect Surveys: GOM**	A towed continuous plankton recording device is deployed from vessels of opportunity in the Gulf of Maine, monthly.	Towed array	Continuous Plankton Recorder	Maine to Nova Scotia	24

2.1 Status Quo/No Action

The range of alternatives evaluated in this SPEA must achieve the objectives of the proposed action as described in Section 1.3, Purpose and Need. The alternative must not violate any of the minimum environmental standards listed in Chapter 1, Table 1-1. The purpose and need also helps determine which alternatives are carried forward for analysis in the SPEA. An alternative that does not satisfy the agency's purpose and need objectives or does not meet minimum environmental standards is not considered reasonable and would not be carried forward for evaluation. An alternative cannot be arbitrarily dismissed from further analysis; justification must be provided for the elimination of an alternative from further consideration. In this case, a No Action alternative that would mean no fisheries research, would not meet the agency's purpose and need stated in Chapter 1. Therefore, the No Action considered in this SPEA is described as the Status Quo.

Survey data evaluated for the 2016 PEA were from research activities conducted between 2008-2012, and the Status Quo Alternative described in NMFS (2016b) was to perform fisheries and ecosystem research as it was conducted from 2008 through 2012. However, since 2016 the fisheries research program was reduced in effort by approximately 70% from that described as Status Quo Alternative in the 2016 PEA. This significant reduction in effort was largely due to recent reductions in the annual budget. Therefore, for the purposes of this assessment and to present Status Quo that most accurately reflects the more current level of research, NEFSC fisheries research conducted in 2017 serves as the Status Quo Alternative for this SPEA (Table 2-1).

The No Action or Status Quo Alternative, which must be considered according to CEQ regulations, would allow only fisheries research activities that are currently conducted under existing permits valid through 2021. New permits issued in 2021 to replace the existing permits would mirror what was permitted for research conducted from 2016 through 2021 as described in the 2016 PEA (NMFS 2016b). Research activities, equipment, gear, sample sizes, and objectives would not change for future research conducted between 2021–2026.

A summary of surveys under the Status Quo alternative are shown in Table 2-1. A detailed description of surveys under each alternative, as well as gear used and average range for Days-At-Sea (DAS) is provided in Table 2-2. NEFSC research since 2016 included the following mitigation measures that were developed in consultation with marine mammal scientists and other protected species experts to safeguard protected species. Mitigation measures implemented under the Status Quo are described in detail in Table 2-3:

- Continued coordination and communication with NOAA's Office of Marine and Aviation Operations (OMAO) and other relevant parties to review the mitigation measures to be implemented;
- Pre-determined vessel speeds during activities;
- Marine mammal handling procedures and record-keeping requirements;
- Visual monitoring for protected species upon arrival to station, during deployment of gear, active fishing and gear retrieval. Use of the "move-on" rule if protected species are at risk of interaction with gear. If protected species are still observed after moving on, the vessel may move again or a

station may be skipped based on the professional judgment of the Chief Scientist or officer on watch. Dredge gear will not be deployed if protected species are at risk of interaction;

- NEFSC-affiliated research vessels adhere to several mitigation measures which were implemented to minimize the risk of vessel collisions with right whales. When NEFSC vessels are operating in right whale Seasonal Management Areas, Dynamic Management Areas, or at times and locations when whales are otherwise known to be present, they operate at speeds no greater than 10 knots. In addition, NEFSC research vessel captains and crew watch for marine mammals while underway during daylight hours and take necessary actions to avoid them;
- NEFSC fisheries research surveys and programs, including short-term cooperative research projects, comply with the gear requirements and operational limits consistent with Take Reduction Plans that are in place throughout the NEFSC research area for several protected species of marine mammals;
- Short tow times and set times of 30 minutes or less for most trawl surveys to reduce exposure of protected species to research gear thereby reducing the likelihood of attracting and incidentally taking protected species;
- Standard tow times of 15 minutes for distances less than 1nm for scallop dredging and 10 minutes for clam dredging;
- Gillnets will be deployed upon arrival on site to the extent practicable. Gillnets are not deployed if protected species have been sighted upon arrival. If a sea turtle or marine mammal is sighted during the soak and appears to be at risk of interaction with the gear, then the gear is pulled immediately;
- COASTSPAN gillnet surveys shall actively monitor for potential bottlenose dolphin entanglements by hand-checking the gillnet every 20 minutes;
- Continue to identify and review potential factors influencing incidental take of protected species;
- Continue providing the mitigation and monitoring training program for Chief Scientists and crew responsible for implementing appropriate responses to protected species interactions;

TABLE 2-3. SUMMARY OF MITIGATION MEASURES BY SURVEY TYPE AND GEAR TYPE FOR ALTERNATIVES 1 AND 2

Measures	Alternative 1 (Status Quo/No Action)	Alternative 2
General Measures Applicable to All Surveys	• Coordination and Communication: In advance of each survey, coordination with the NOAA OMAO or other relevant parties to ensure clear understanding of the mitigation measures and the manner of their implementation. Conduct briefings at the outset of each survey and as necessary with the ship's crew and coordinate daily as necessary during survey cruises. Chief scientist (CS) to coordinate with Officers on Deck (OOD) or equivalent to ensure procedures are understood. • Protected Species Training: Conduct a formalized protected species training program for all crew members that are part of NEFSC-affiliated research and cooperative research. Training will include topics such as monitoring and sighting protocols, species identification, decision-making factors avoiding take, procedures for handling and documenting protected species interactions, and reporting requirements. • Vessel Speed and Distances: If vessel crew or dedicated marine mammal observers sight marine mammals that may intersect the vessel, they will immediately communicate with the bridge for appropriate course alteration or speed reduction as possible. If a vessel 65 ft or longer is traveling within a North Atlantic Right Whale Seasonal Management Area, do not exceed 10 knots. When practicable, all NEFSC vessels traveling within a Dynamic Management Area shall not exceed 10 knots. Maintain a distance of 500 m and 100 m from North Atlantic right whales and other large whales, respectively. • Handling Procedures: Implement NEFSC established protocols to reduce interaction with marine mammals following a step-wise order; 1) ensure health and safety of crew; depending on how and where an animal is hooked or entangled, take action to prevent further injury to the animal; 3) take action to increase the animal's chance of survival; and 4) record detailed information on the interaction, actions taken and observations of the animal throughout the incident. • Genetic Sampling: If a mortality of a bottlenose dolphin from a stock of unknown origin occurs due to entanglement, NEFSC must photograph the dorsal fin to submit to the Regional Stranding Coordinator and request expedited genetic sampling for stock determination.	
Surveys Using Trawl Gear	• For all beam, mid-water, and bottom trawl, the OOD, CS or other member) and crew standing watch on the bridge will scan for protected species using binoculars during all daytime operations. • Initiate protected species watches (visual observation) 15 minutes prior to sampling within 1 nm of of the. Scan the surrounding waters with the naked eye and rangefinding binoculars. • If protected species are sighted within 1 nm of the station in the 15 minutes before setting the gear, the OOD may decide to implement the "move-on" rule and transit to a different section of the sampling area. Trawl gear will not be deployed if protected species are sighted near the ship unless there is no risk of interaction as determined by the OOD or CS. • After moving on, if protected species are still visible from the vessel and appear at risk, the OOD may decide to move again or skip the station. The OOD and CS may discuss strategies for avoid takes of these species. • If trawling is delayed because of protected species presence, NEFSC may resume only after there are no sightings for 15 minutes within 1nm of sampling location. • Conduct trawl operations upon arrival on station to the extent practicable. • Continue visual monitoring while gear is deployed. If protected species are sighted before gear retrieval, the CS, watch leader, or OOD will determine the best action to minimize interactions with animals.	

<table>
<tr><th>Measures</th><th>Alternative 1 (Status Quo/No Action)</th><th>Alternative 2</th></tr>
<tr><td>Surveys Using Trawl Gear cont'd.</td><td colspan="2">• During nighttime operations, observe with the naked eye and any available vessel lighting.
• If deploying bongo plankton or other small net prior to trawl gear, continue visual observations until trawl gear is ready to deploy.
• Conduct standard tow durations of no more than 30 minutes at target depth for distances less than 3 nm. The exceptions to the 30-minute tow duration are the Atlantic Herring Acoustic Pelagic Trawl Survey and the Deepwater Biodiversity Survey where total time in the water (deployment, fishing, and haul-back) is 40 to 60 minutes and 180 minutes, respectively.
• Clean gear prior to deployment. Empty gear as quickly as possible to ensure no marine mammals are entangled.</td></tr>
<tr><td>Surveys Using Dredge Gear</td><td colspan="2">• For all scallop and hydraulic clam dredges, the OOD, CS or other crew members and crew standing watch on the bridge will scan for marine mammals using binoculars during all daytime operations.
• Initiate protected species prior to sampling. Scan the surrounding waters with the naked eye and range finding binoculars.
• If protected species are sighted within 1 nm 15 minutes before setting the gear, the OOD may decide to implement the "move-on" rule and transit to a different section of the sampling area. Dredge gear will not be deployed if marine mammals are sighted near the ship unless there is no risk of interaction as determined by the OOD or CS.
• After moving on, if protected species are still visible from the vessel and appear at risk, the OOD may decide to move again or skip the station. The OOD and CS may discuss strategies for avoid takes of these species.
• If dredging is delayed because of marine mammal presence, operations only resume when the animals have not been sighted for 15 minutes.
• Conduct dredge operations upon arrival on station to the extent practicable.
• Continue visual monitoring while gear is deployed. If protected species are sighted before gear retrieval, the CS, watch leader, or OOD will determine the best action to minimize interactions with animals.
• During nighttime operations, observe with the naked eye and any available vessel lighting.
• Conduct standard tow durations of no more than 15 minutes at target depth for distances less than 1 nm for scallop dredging and 10 minutes for clam dredging.
• Clean gear prior to deployment. Empty gear as quickly as possible to ensure no protected species are entangled.</td></tr>
<tr><td>Longline Surveys</td><td>• Deploy longline gear as soon as practicable upon arrival on station.
• Initiate visual observation for protected species no less than 30 minutes prior to deployment and retrieval of gear. Scan surrounding waters with the naked eye and binoculars (or monocular). Conduct visual observations during nighttime surveys using the naked eye and available vessel lighting.
• If protected species are sighted within 30 minutes before setting gear, implement the move-on rule if species appears at risk of interaction with gear. If, after moving on, protected species are still visible from the vessel, NEFSC will use professional judgment about whether to move again or skip the station.</td><td>• Initiate visual observation for protected species no less than 15 minutes prior to deployment and retrieval of gear. Scan surrounding waters with the naked eye and binoculars (or monocular). Conduct visual observations during nighttime surveys using the naked eye and available vessel lighting.
• If protected species are sighted within 15 minutes before setting gear, implement the move-on rule if species appears at risk of interaction with gear. If, after moving on, protected species are still visible from the vessel, NEFSC will use professional judgment about whether to move again or skip the station.</td></tr>
</table>

Measures	Alternative 1 (Status Quo/No Action)	Alternative 2
Longline Surveys cont'd.	• For Apex Predators Bottom Longline Coastal Shark Survey, if one or more marine mammals are observed within 1nm of station within 30 minutes before gear deployment, transit to a different section of sampling area to maintain minimum distance of 1nm from marine mammal(s). Use professional judgment whether to move again or forego sampling if marine mammal(s) remain within 1nm of sampling location. • If gear deployment or retrieval is suspended due to presence of marine mammals, resume operations only after there are no sightings for at least 15 minutes within 1nm of sampling location. • Chumming is prohibited.	• For Apex Predators Bottom Longline Coastal Shark Survey, if one or more marine mammals are observed within 1nm of station within 15 minutes before gear deployment, transit to a different section of sampling area to maintain minimum distance of 1nm from marine mammal(s). Use professional judgment whether to move again or forego sampling if marine mammal(s) remain within 1nm of sampling location • All other measures are the same as Alternative 1.
Rotary Screw Trap Surveys	• Conduct rotary screw trap deployments as soon as is practicable upon arrival at the sampling site. • Initiate visual observation for marine mammals in the area prior to setting and retrieval of the rotary screw trap gear. If marine mammals are observed in the sampling area, NEFSC shall suspend or delay the sampling. NEFSC may use best professional judgement in making this decision. • Tend to the trap on a daily basis to monitor for marine mammal interactions with the gear. • If the rotary screw trap catches a marine mammal, NEFSC shall carefully remove and implement best handling practices.	
Pot/Trap Surveys	• Same protocols as longline.	
Fyke Net Surveys	• Deploy gear as soon as practicable upon arriving at station. • Conduct monitoring and retrieval of gear every 12- to 24-hour soak period. • A 2-m fyke net will be fitted with a Marine Mammal Excluder Device (MMED). • If marine mammals are within 100 m of setting location, consider moving. If there is risk of interaction with marine mammals, retrieve gear.	
Gillnet Surveys	• For all gillnet deployments, the OOD, CS or other member and crew standing watch on the bridge will scan for marine mammals and sea turtles using binoculars during all daytime operations. • Initiate marine mammal watches upon arrival on station. Scan the surrounding waters with the naked eye and range finding binoculars. • Deploy acoustic pingers in areas where required for commercial fisheries. • If marine mammals or sea turtles are sighted within 1 nm 15 minutes before setting the gear, the OOD may decide to implement the "move-on" rule and transit to a different section of the sampling area. Gillnet gear will not be deployed if sea turtles or marine mammals are sighted near the ship unless there is no risk of interaction as determined by the OOD or CS. • After moving on, if marine mammals or sea turtles are still visible from the vessel and appear at risk, the OOD may decide to move again or skip the station. The OOD and CS may discuss strategies to avoid takes of these species.	

<table>
<tr><th>Measures</th><th>Alternative 1 (Status Quo/No Action)</th><th>Alternative 2</th></tr>
<tr><td>Gillnet Surveys cont'd.</td><td colspan="2">If placement of the gillnet is delayed because of sea turtle or marine mammal presence, operations only resume when the animals have no longer been sighted or are no longer at risk. If a marine mammal or sea turtle is sighted during the soak and appears to be at risk of interaction with the gear, then the gear is pulled immediately.
Conduct gillnet operations upon arrival on station to the extent practicable.
Continue visual monitoring while gillnet is soaking. If marine mammals or sea turtles are sighted before gear retrieval, the CS, watch leader, or OOD will determine the best action to minimize interactions with animals.
Clean gear prior to and during deployment. Empty gear as quickly as possible to ensure no marine mammals or sea turtles are entangled. For the COASTSPAN gillnet surveys, NEFSC shall actively monitor for potential bottlenose dolphin entanglements by hand-checking the gillnet every 30 minutes.</td></tr>
</table>

Research activities, equipment, gear, sample sizes, and objectives would not change for future research conducted 2020–2025 under the Status Quo Alternative. NMFS previously conducted an extensive analysis of the Preferred Alternative in the 2016 PEA (NMFS 2016b) which includes those measures being considered under the Status Quo in this SPEA. The 2016 PEA addressed all resources under the responsibility and jurisdiction of NMFS that had the potential to be impacted as a result of the Proposed Action and Alternative Actions. This SPEA will address any remaining significant impacts or issues that have been newly identified since NMFS (2016b). However, given the significantly reduced level of effort between the Status Quo described in NMFS (2016b) for period 2008-2012 as compared to the Status Quo based on the 2017 level of effort, it is reasonably certain that any impacts from the SPEA Status Quo Alternative would be significantly less than the impact of the Status Quo alternative as analyzed in the 2016 PEA. Also, it is equally clear that the overall impact of the surveys and research projects identified in the current Status Quo Alternative should have no more than a negligible or minor difference when compared to level of impact from the same surveys that were previously analyzed as part of the 2016 Status Quo Alternative.

2.2 Alternative 2: Preferred Alternative (Future Research Beginning 2021)

Alternative 2 includes all of the studies described in Alternative 1 (Status Quo/No Action) plus additional research that was not previously analyzed in the 2016 PEA (NMFS 2016b). While most of the surveys listed under Alternative 2 are the same as the 2016 PEA Preferred Alternative (now referred to as Alternative 1/Status Quo), new activities and proposed gear are highlighted in this section and analyzed in Chapter 4. Perhaps one of the most notable changes in research since the 2016 PEA is the level of research effort. As described in Section 2.1, NEFSC research effort was significantly reduced during the period 2016–2018 due to limited funding or because projects were discontinued. For the period 2021-2026, NEFSC may continue or re-initiate research projects listed in bold, italics in Table 2-2. Alternative 2 also includes certain modifications to surveys conducted under Status Quo/No Action. For example, the Deepwater Biodiversity western pelagic trawl study proposed for the western north Atlantic may include the use of acoustics, optics, eDNA, collection of additional oceanographic data and some research and development of new assessment tools. Future research beginning in 2021 would fall within the level of effort presented as DAS in Table 2-2.

Alternative 2 also includes additional U.S. participation in international research. For example, tagging of sub-adult Atlantic salmon (*Salmo salar*) within the Igaliku Fjord in southwest Greenland by NEFSC researchers in cooperation with researchers from the Department of Fisheries and Oceans Canada (DFO) and the Atlantic Salmon Federation is a follow-up study to research originally conducted in 2010 through 2012 that was not specifically analyzed in the 2016 PEA. This research project was conducted in 2018 and targets Atlantic salmon from non-listed populations that migrate to Greenland as sub-adults and spend two years in marine waters foraging off the Greenland coast before returning to natal streams primarily in Canada and Europe.

International work does not require authorization under the MMPA or ESA. Instead, NMFS must follow the applicable laws of the lead country. EO 12114 (January 1979) Environmental Effects Abroad of Major Federal Actions requires that federal agencies taking major federal actions outside of the geographical boundaries of the U.S. and its territories and possessions shall exchange information concerning the environment on a continuing basis. EO12114 also exempts activities that would not result in significant effects on the environment. International research is discussed further in Chapter 4 Environmental Consequences.

The NEFSC considers the current suite of mitigation and monitoring measures to be necessary to avoid adverse interactions with protected species and still allow the NEFSC and its cooperating partners to fulfill their scientific missions. Therefore, with several exceptions regarding the length of observation during longline surveys, the mitigation measures currently in place under Status Quo/No Action (Alternative 1) are also proposed under Alternative 2 and would continue to be implemented for the period 2021-2026 (see Table 2-3). Based on input from researchers, NEFSC proposes to modify mitigation measures for most surveys as follows (proposed change shown in bold) (see Table 2-3 for additional detail):

- Initiate visual observation for protected species **within 1 nm** no less than **15 minutes** prior to deployment and retrieval of gear. Scan surrounding waters with the naked eye and binoculars (or monocular). Conduct visual observations during nighttime surveys using the naked eye and available vessel lighting.
- If protected species are sighted within **1 nm 15 minutes** before setting gear, implement the move-on rule if species appears at risk of interaction with gear. If, after moving on, protected species are still visible from the vessel, NEFSC will use professional judgment about whether to move again or skip the station.
- For Apex Predators Bottom Longline Coastal Shark Survey, if one or more marine mammals are observed within 1nm of the station within **15 minutes** before gear deployment, transit to a different section of sampling area to maintain minimum distance of 1nm from marine mammal(s). Use professional judgment whether to move again or forego sampling if marine mammal(s) remain within 1nm of sampling location.
- If a vessel 65 ft or longer is traveling within a **North Atlantic Right Whale Seasonal Management Area**, **do not exceed 10 knots**. When practicable, all NEFSC vessels traveling within a **Dynamic Management Area shall not exceed 10 knots. Maintain a distance of 500 m and 100 m** from North Atlantic right whales and other large whales, respectively.

This SPEA will address proposed changes in surveys or survey design or other issues that have been newly identified since the 2016 PEA (NMFS 2016b) . In addition, this SPEA presents an analysis to address previous concerns of data gaps identified by GARFO and NEFSC. Since publication of the 2016 PEA, NEFSC and GARFO have expressed concern about challenges in assessing potential fish mortality associated with fishery-independent research conducted and funded by NEFSC. Specifically, NEFSC and GARFO lacked the ability to adequately calculate total regulated fish catch due to research. During the period when the 2016 PEA was being developed, some datasets were not reported consistently or in a format that allowed assessment of total fish catch. These data gaps limited the ability of GARFO to use the 2016 PEA to assess impacts of additional projects or programs under NEPA for the LME of the east coast of the U.S. Since 2016, an effort has been made to collate and synthesize fisheries data consistently to support evaluation of total catch from NEFSC research. Chapter 4 of this SPEA presents this analysis and addresses these data gaps identified by GARFO and NEFSC.

3 AFFECTED ENVIRONMENT

Chapter 3 of the 2016 PEA (NMFS 2016b) provides a comprehensive summary of physical, biological and socioeconomic resources that characterize the affected environment within the Project Area. As a supplement to the 2016 PEA, this section describes updates to only those resources of the environment that have exhibited a change in status or condition, or that may be affected by the new proposed research activities that were not previously considered in the 2016 PEA. At the beginning of each resource category, a summary table provides references to the sections of the 2016 PEA where detailed information about resources is described. The summary tables also indicate whether any changes to resources since publication of the 2016 PEA are relevant for this evaluation of proposed fisheries and ecosystem research. In other words, if a change in the physical, biological or socioeconomic environment could result in conclusions different from those presented in the 2016 PEA, an update to those resources is presented in this chapter. If changes to physical, biological or socioeconomic resources do not alter the conclusions from the 2016 PEA, those resources are not discussed further in this SPEA. A discussion of potential impacts of proposed research alternatives on the affected environment (i.e., resources) is presented in Chapter 4. Chapter 4 also provides an overview of potential cumulative effects due to external factors such as climate change that may impact resources within the Action Area.

3.1 Physical Environment

NEFSC fisheries research activities are conducted off the Atlantic coast of the U.S., primarily within 320 km of the shoreline from Cape Hatteras, North Carolina to the U.S.-Canada border. This primary research area is known as the Northeast U.S. Continental Shelf Large Marine Ecosystem (NE LME). Large Marine Ecosystems or LMEs are large areas of coastal ocean space (Sherman *et al.* 1996, Sherman *et al.* 2004). LMEs generally include ocean surface areas greater than 123,000 km^2 and are located in coastal waters where primary productivity is generally higher than in open ocean areas. LME physical boundaries are based on four ecological criteria: bathymetry, hydrography, productivity, and trophic relationships.

As described in Section 3.1 of the 2016 PEA, the NE LME is divided into four major subareas, and includes the GOM, GB, Southern New England (SNE), and the Mid-Atlantic Bight (MAB) (Figure 3-1). A small number of NEFSC survey activities extend south into the Southeast U.S. Continental Shelf LME and north into the Scotian Shelf LME. However, the majority of NEFSC research activities occur within the NE LME. NMFS previously conducted an extensive analysis of the impacts of NEFSC fisheries research activities on the physical environment in the 2016 PEA. The 2016 PEA addressed all physical environmental resources under the responsibility and jurisdiction of NMFS (as identified in Table 3-1) that had the potential to be impacted as a result of the proposed and alternative actions at that time.

Since 2016, there have been minor changes to some special resource areas within the Project Area as summarized in Table 3-1 and described briefly in this section. Chapter 4 of this SPEA will address any new or different issues that were not identified in the 2016 PEA (NMFS 2016b).

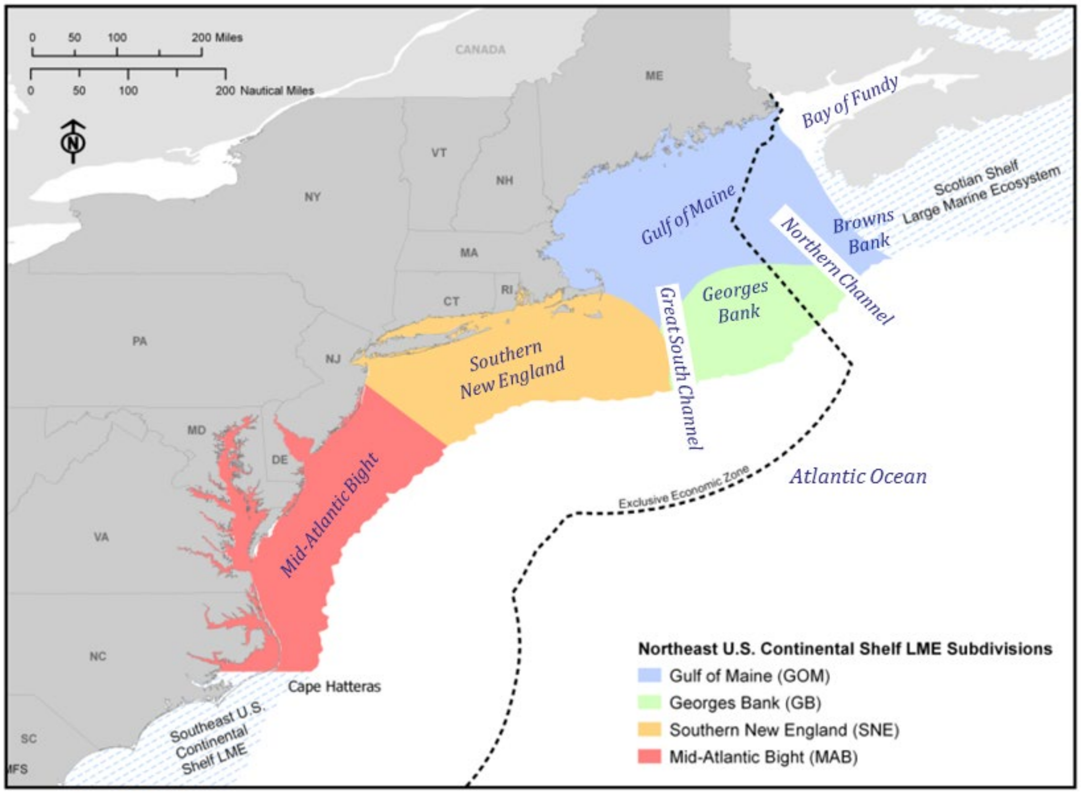


FIGURE 3-1. SUBDIVISIONS OF THE NE LME

TABLE 3-1. PHYSICAL ENVIRONMENT STATUS SUMMARY

<table>
<tr><th>Special Resource Area</th><th>2016 PEA Section Reference</th><th>Update Since 2016 Requiring Evaluation? (Yes/No)</th><th>Reference</th><th>Description</th></tr>
<tr><td>Essential Fish Habitat</td><td>3.1.2.1</td><td>Yes</td><td rowspan="4">83 FR 15240
85 FR 29870
85 FR 285</td><td rowspan="4">New England Fishery Management Council’s Omnibus Essential Fish Habitat Amendment 2. This rule revises essential fish habitat and habitat area of particular concern designations, revises or creates habitat management areas, including gear restrictions, to protect vulnerable habitat from fishing gear impacts, establishes dedicated habitat research areas, and implements several administrative measures related to reviewing these measures, as well as other regulatory adjustments to implement these measures.

On May 19, 2020, NMFS published a final rule for the Habitat Clam Dredge Exemption Framework to establish three areas within the Great South Channel Habitat Management Area where vessels may fish for Atlantic surfclams or blue mussels with dredge gear. This action is intended to provide the fishing industry access to part of the surfclam and blue mussel resource within the Habitat Management Area while balancing the Council’s habitat conservation objectives.

On January 3, 2020, NMFS published a proposed rule to implement an Omnibus Deep-Sea Coral Amendment to protect deep-sea corals from impacts from commercial fishing gear on Georges Bank and the Gulf of Maine.</td></tr>
<tr><td>Habitat Areas of Particular Concern</td><td>3.1.2.2</td><td>Yes</td></tr>
<tr><td>Closed Areas</td><td>3.1.2.3</td><td>Yes</td></tr>
<tr><td>Marine Protected Areas</td><td>3.1.2.4</td><td>Yes</td></tr>
<tr><td>National Marine Sanctuaries

Stellwagen Bank</td><td>3.1.2.4</td><td>Yes</td><td>83 FR 15240</td><td>Stellwagen Bank Designated Habitat Research Area (DHRA) (see above).</td></tr>
<tr><td>Monitor</td><td>3.1.2.4</td><td>Yes</td><td>81 FR 879</td><td>In 2016, NOAA proposed to expand Monitor NMS to include a collection of nearby World War II shipwrecks known as the “Graveyard of the Atlantic.”</td></tr>
<tr><td>Gray’s Reef</td><td>3.1.2.4</td><td>Yes</td><td>83 FR 38684</td><td>On August 7, 2018 NOAA published a notice requesting public comment on four draft PEAs related to continued field operations at each of the 13 NMS and two Marine National Monuments.</td></tr>
</table>

3.1.1 Essential Fish Habitat (EFH), Habitat Areas of Particular Concern (HAPC), and Closed Areas

On January 3, 2018, NMFS approved the majority of the New England Fishery Management Council's recommendations for the Omnibus Essential Fish Habitat Amendment 2 (OHA2). To ensure compliance with MSA, OHA2 included review and revisions to EFH designations and development of actions to minimize the adverse effects of fishing on EFH. OHA2 also approved the Council's recommendations for existing HAPCs for Atlantic salmon and juvenile cod (Northern Edge Juvenile Cod HAPC). The action also included the following areas as new HAPCs: Inshore Juvenile Cod HAPC; Great South Channel Juvenile Cod HAPC; Cashes Ledge HAPC; Jeffreys Ledge/Stellwagen Bank HAPC; Bear and Retriever Seamount HAPC; and 11 canyon/canyon complexes. The canyon/canyon complexes include: Heezan Canyon; Lydonia, Gilbert and Oceanographer Canyons; Hudson Canyon; Toms, Middle Tom and Hendrickson Canyon; Wilmington Canyon; Baltimore Canyon; Washington Canyon; and Norfolk Canyon); and two seamounts (Bear and Retriever). On October 28, 2019, Federal District Court Judge James E. Boasberg issued an Order and Opinion on a lawsuit challenging a portion of OHA2. The Order prohibits NMFS from allowing gillnet fishing in the former Nantucket Lightship Groundfish and the Closed Area I Groundfish Closure Areas, until NMFS has "fully complied with requirements of the ESA and the MSA". Following the Order (Civil Action No. 18-1087 (JEB)), NMFS notified all gillnetters on November 1, 2019 that all gillnet gear needed to be removed from these two areas. NMFS issued a final rule on December 16, 2019 closing these areas, consistent with safe vessel operations.

Details of the actions implemented through OHA2 are described in detail in the Omnibus Essential Fish Habitat Amendment 2, including the Environmental Impact Statement, the Regulatory Impact Review, and the Initial Regulatory Flexibility Analysis (EIS/RIR/IRFA). Coordinates for OHA2 Closed Area I and the Nantucket Lightship Closed Area are shown in Table 3-2.

TABLE 3-2. COORDINATES FOR OHA2 CLOSED AREA I AND NANTUCKET LIGHTSHIP CLOSED AREA

Point	N. Latitude	W. Latitude
CI1	41°30′	69°23′
CI2	40°45′	68°45′
CI3	40°45′	68°30′
CI4	41°30′	68°30′
CI1	41°30′	69°23′

Modifications to existing closures, removal of certain closures or the addition of new closures areas were included in Amendment 2 including areas in the Eastern Gulf of Maine, Central Gulf of Maine, Western Gulf of Maine, and Georges Bank as follows. The coordinates of closed areas are also provided below.

- Establish the (Small) Eastern Maine Habitat Management Area (HMA), closed to mobile bottom-tending gear;
- Maintain Cashes Ledge (Groundfish) Closure Area, with current restrictions and exemptions[2];
- Modify the Cashes Ledge Habitat Closure Area, closed to mobile bottom-tending gear;
- Modify the Jeffreys Ledge Habitat Closure Area, closed to mobile bottom-tending gear;
- Establish the Ammen Rock HMA, closed to all fishing, except lobster traps;
- Establish the Fippennies Ledge HMA, closed to mobile bottom-tending gear;
- Maintain the Western Gulf of Maine Habitat Closure Area, closed to mobile bottom-tending gear;
- Modify the Western Gulf of Maine Groundfish Closure Area to align with the Western Gulf of Maine Habitat Closure Area, with current restrictions and exemptions;
- Exempt shrimp trawling from the designated portion of the northwest corner of the Western Gulf of Maine Closure Areas;
- Add the Gulf of Maine Roller Gear restriction as a habitat protection measure;
- Remove the Closed Area I Habitat and Groundfish Closure Area designations;
- Remove the Nantucket Lightship Habitat and Groundfish Closure Area designations; and
- Establish the Great South Channel HMA, closed to mobile bottom-tending gear throughout and clam dredge gear in the defined northeast section. Clam dredge gear would be permitted throughout the rest of the HMA for one year while the Council considers more refined restrictions (83 FR 12540).

Two Dedicated Habitat Research Areas (DHRA), effective for three years, were created by OHA2 including Georges Bank DHRA and the Stellwagen Bank DHRA. The Georges Bank DHRA is closed to all commercial mobile bottom-tending gear but would open within three years if no research is initiated, funded, or proposed. The Stellwagen Bank DHRA is closed to all commercial mobile bottom-tending gear, commercial sink gillnet gear, and commercial demersal longline gear. These DHRAs are particularly focused on evaluating assumptions related to the Swept Area Seabed Impact model used by the Council for decision making regarding habitat protection. A primary purpose of DHRA's is to ultimately improve habitat and ecosystem model forecasts and inform future habitat management through improved information to managers and a better understanding of the ecological effects of fishing across a range of habitats (NEFSC and NMFS 2016). DHRAs

[2]Exemptions include: Charter and party* or recreational vessels; vessels fishing with exempted gears (spears, rakes, diving gear, cast nets, tongs, harpoons, weirs, dip nets, stop nets, pound nets, pots and traps, purse seines, surf clam/ quahog dredge gear, pelagic hook and line, pelagic longlines, single pelagic gillnets, and shrimp trawls (with properly configured grates)); and vessels participating in the mid-water trawl exempted fishery (50 CFR 648.81, § 648.370, and. § 648.371).

allow coordinated research and build upon past studies and baselines. The Council developed a series of questions to help determine what role DHRA's will play in future habitat-related research (83 FR 12540).

On May 19, 2020, NMFS published a final rule for the Habitat Clam Dredge Exemption Framework. The 2020 rule implements three dredge exemption areas (McBlair, Old South, and Fishing Rip) within the GSC HMA where vessels can fish for surfclams or blue mussels. For the specific locations (i.e., latitude and longitude coordinates) of these areas, please see Tables 1 and 2 of the final rule 85 FR 29870. Exemption areas allow limited access to historical surfclam fishing grounds that seem less vulnerable to adverse habitat impacts from dredge gear but maintain protection for the majority of the HMA from the adverse habitat impacts caused by dredge gear.

NMFS published a proposed rule on January 3, 2020 to implement the New England Fishery Management Council's Omnibus Deep-Sea Coral Amendment to protect deep-sea corals from impacts from commercial fishing gear on Georges Bank and the Gulf of Maine. Coral protection zones were initially developed during 2010 and 2011 as part of the Council's OHA2 described above. In September 2012, the Council split the coral protection zones and associated management measures out of OHA2 into a separate omnibus amendment. This Amendment is still under development.

3.1.2 National Marine Sanctuaries

Monitor NMS Boundary Expansion: In 2016, ONMS published a notice of intent to conduct scoping and prepare an EIS to consider expanding Monitor NMS to encompass an area off coastal North Carolina that contains some of the most significant shipwrecks in the U.S. The expansion could preserve nationally significant historic wreck sites that include vessels and other artifacts dating back to the Age of North American Exploration, the Revolutionary War, the Civil War and World War II among others (81 FR 879).

3.2 Biological Environment

3.2.1 Fish

Finfish species that occur within the NEFSC research areas are described in detail in Section 3.2.1 of the 2016 PEA. The following subsections focus only on species that may have had changes since 2016 (i.e., biologically or in terms of management), that require evaluation in this SPEA considering proposed research described in Chapter 2.

3.2.1.1 Fish Species Listed Under the Endangered Species Act

The 2016 PEA describes six fish species/Distinct Population Segments (DPSs) that are listed as either endangered or threatened under the ESA that occur within the NEFSC research area (Table 3-3). Table 3-3 and species descriptions that summarize recent status reviews and regulatory actions for ESA-listed species since publication of the 2016 PEA and Biological Opinion (BiOp) for NEFSC fisheries research. As required for compliance with the ESA, all species listed as threatened or endangered that occur within the Project Area will be evaluated in the BiOp that will accompany the SPEA. However, this does not mean all ESA-listed species require evaluation under the SPEA proposed alternatives; rather, it depends on whether the scope of activities has the potential to impact those species as indicated in Table 3-3 (Description column).

TABLE 3-3. SUMMARY OF CHANGES TO ESA-LISTED FISH SPECIES WITHIN THE PROJECT AREA SINCE THE 2016 PEA AND BIOLOGICAL OPINION

ESA-Listed Species[1]	2016 PEA Section Ref.	SPEA Evaluation Required? (Yes/No)	References	Description
Atlantic Salmon **GOM DPS (E)**	3.2.1.1	Yes	83 FR 15240; Kocik (2019)	No change in ESA-listed status. Tagging research project in Greenland by NEFSC takes up to 100 fish per year by trolling. The directed commercial fishery for Atlantic salmon in West Greenland ended in 2018 which will increase survival primarily in Canada, but also the GOM DPS. Further evaluation under SPEA alternatives warranted due to listed status. A Recovery Plan for this DPS prepared by USFWS and NOAA in close collaboration with MDMR and the Penobscot Indian Nation was released on February 12th, 2019.
Atlantic Sturgeon **GOM southern DPS (T)** **All other DPSs (E)**	3.2.1.1	No	83 FR 11731 82 FR 39160	In 2018, NMFS initiated a 5-year review of threatened GOM DPS of Atlantic sturgeon, endangered New York Bight DPS, endangered Chesapeake Bay DPS, endangered Carolina DPS and endangered South Atlantic DPS. On Aug 17, 2017, critical habitat was designated for all DPSs. Management changes do not require further evaluation under SPEA alternatives.
Shortnose Sturgeon (E)	3.2.1.1	Yes	80 FR 65183	October 26, 2015, NMFS published a findings that the Saint John's River, New Brunswick, Canada, DPS of shortnose sturgeon was found not to constitute a DPS and therefore was not delisted under the ESA. Given the scope of NEFSC research, further evaluation under SPEA alternatives is warranted because takes can occur.
Smalltooth Sawfish (E)	3.2.1.1	No	USFWS Accessed Sept. 8, 2019	No change in status. Based on the limited data on the occurrence of smalltooth sawfish north of Florida (NMFS 2018c), this species is expected to be extremely rare north of coastal Florida.
Oceanic whitetip shark (T)	3.2.1.3	Yes	83 FR 4153	Listed as threatened under the ESA January 30, 2018.
Giant manta ray (T)	3.2.1.3	Yes	83 FR 2916	Listed as threatened under the ESA January 22, 2018.

[1]ESA-listing status includes Endangered (E), Threatened (T) or Candidate Species (50 CFR 17.11).

As shown in Table 3-3, an Atlantic salmon tagging project occurred off the West Greenland coast which is included in the new scope of research covered by this SPEA (see also Section 2.2). Importantly, the Greenland commercial fishery for Atlantic salmon was closed in 2018 (see details below). In 2017, critical habitat was designated for several DPS of sturgeon. The St. Johns River DPS of shortnose sturgeon was delisted but for the most part this DPSs range occurs north of the NE LME and Action Area.

The oceanic whitetip shark was listed as threatened on January 30, 2018 (see Table 3-3). Two scalloped hammerhead shark DPSs (Central and SW Atlantic and Indo-West Pacific) were listed as threatened on July 3, 2014 (79 FR 38214). The northern boundary of the Central and SW Atlantic DPS extends northward only to central Florida waters. NEFSC surveys are not expected to interact with this DPS. The NW and GOM DPS of scalloped hammerhead sharks is not listed and is discussed in Section 3.2.1.2. Smalltooth sawfish are also extremely rare north of Florida and are not discussed further.

3.2.1.1.1 Atlantic Salmon

The International Council for the Exploration of the Sea (ICES 2019) reported that Atlantic salmon of North American origin comprised up to 83.1% of commercial catch off West Greenland, suggesting that a large portion of fish from North America contribute to the fishery (see Figure 5.2.2.3 of ICES 2019). Approximately 32.4 tons (t) of North American salmon were harvested in 2018, not including unreported catch. The West Greenland fishery is dominated by North American salmon from the Gaspe Peninsula, the Gulf of St. Lawrence, and the Labrador South reporting groups. These three groups accounted for 71% of the North American contributions in 2017 and 70% in 2018 (ICES 2019).

While the estimated exploitation rate of salmon in North American fisheries that are of North American origin has declined from peaks of 81% in 1971 to a mean of 10% over the past ten years, there are populations at risk of extinction in the southern areas of Nova Scotia-Fundy and USA. These populations are federally protected or are under consideration for protection. There were no recreational or commercial fisheries for anadromous Atlantic salmon in the US in 2018 (ICES 2019).

In May 2018, the Atlantic Salmon Federation (ASF) and the North Atlantic Salmon Fund (NASF) signed an agreement with commercial fishermen in Greenland and the Faroe Islands to protect adult wild Atlantic salmon from commercial nets and longlines. The new Greenland Salmon Conservation Agreement closes commercial fishing for salmon for a period of 12-years (2018-2029) and will increase the number of salmon returning to their natal rivers in North America and Europe (ASF 2019).

The Recovery Plan for the Gulf of Maine Distinct Population Segment of Atlantic Salmon has been completed by the USFWS and NOAA in close collaboration with MDMR and the Penobscot Indian Nation and was released on February 12th, 2019 (Kocik 2019).

3.2.1.1.2 Atlantic Sturgeon

On March 16, 2018, NMFS announced their intent to conduct a 5-year review for certain DPSs of Atlantic sturgeon including the threatened GOM DPS, endangered New York Bight DPS of Atlantic sturgeon,

endangered Chesapeake Bay DPS of Atlantic sturgeon, endangered Carolina DPS of Atlantic sturgeon and endangered South Atlantic DPS of Atlantic sturgeon.

On September 18, 2017, NMFS published a final rule designating critical habitat for the GOM, New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs of Atlantic sturgeon (82 FR 39160). Approximately 244 km of aquatic habitat in the following rivers of Maine, New Hampshire, and Massachusetts: Penobscot, Kennebec, Androscoggin, Piscataqua, Cocheco, Salmon Falls, and Merrimack were designated for the GOM DPS. Specific occupied areas were designated for the New York Bight DPS of Atlantic sturgeon containing approximately 547 km of aquatic habitat in the following rivers of Connecticut, Massachusetts, New York, New Jersey, Pennsylvania, and Delaware: Connecticut, Housatonic, Hudson, and Delaware. Approximately 773 km of aquatic habitat in the following rivers of Maryland, Virginia, and the District of Columbia: Potomac, Rappahannock, York, Pamunkey, Mattaponi, James, Nanticoke, and the following another waterbody: Marshyhope Creek were designated as critical habitat for the Chesapeake Bay DPS. Specific occupied areas designated as critical habitat for the Carolina DPS of Atlantic sturgeon contain approximately 1,939 km of aquatic habitat in the following rivers of North Carolina and South Carolina: Roanoke, Tar-Pamlico, Neuse, Cape Fear, Northeast Cape Fear, Waccamaw, Pee Dee, Black, Santee, North Santee, South Santee, and Cooper, and the following other water body: Bull Creek. Lastly, approximately 2,883 km of aquatic habitat was designated as critical in the South Carolina, Georgia, and Florida: Edisto, Combahee-Salkehatchie, Savannah, Ogeechee, Altamaha, Ocmulgee, Oconee, Satilla, and St. Marys Rivers for the South Atlantic DPS of Atlantic sturgeon (82 FR 39160).

3.2.1.1.3 Shortnose Sturgeon

NMFS announced a 12-month finding on October 26, 2015 regarding a petition to delist under the ESA the population of shortnose sturgeon found within the Saint John River in New Brunswick, Canada. Based on the review, NMFS determined that the population of shortnose sturgeon from the Saint John River did not qualify as a DPS and therefore did not propose to delist the population (80 FR 65183). Unlike Atlantic sturgeon, shortnose sturgeon tend to spend relatively little time in the ocean. As a result, critical habitat has not been designated for shortnose sturgeon.

3.2.1.1.4 Oceanic Whitetip Shark

On January 30, 2018, NMFS published a final rule to list the oceanic whitetip shark (*Carcharinus lonigmanus*) as threatened under the ESA (83 FR 4153). While information on the size of the global population of the oceanic whitetip shark is lacking, evidence suggests that the species, once common and abundant, has experienced significant declines globally due to significant fishing pressure and lack of regulatory protection. They are frequently caught in pelagic longline, purse seine, and gillnet fisheries worldwide and their fins are highly valued in the international trade for shark products. Ongoing threats of fishing pressure and related mortality are expected to continue, as the species is still regularly caught as bycatch in global fisheries and incidents of illegal finning and trafficking of their fins have occurred recently despite CITES protections (Young *et al.* 2018). The Northwest Atlantic and Hawaii populations appear to have stabilized and, given the strict fishing regulations in U.S. waters, these stabilizing trends are expected to continue (83 FR 4153). In 2020, NMFS determined that there are no areas within the jurisdiction of the United States that meet the definition of critical habitat for the oceanic whitetip shark (85 FR 12898). Proposed NEFSC research described

in Chapter 2 is not likely to interact with this species. Therefore, oceanic whitetip sharks are not discussed further.

3.2.1.1.5 Giant Manta Ray

On November 10, 2015, NMFS received a petition to list the giant manta ray as threatened or endangered under the ESA throughout its range. In addition, the petition requested that critical habitat be designated alongside the ESA listing. The main threat to the giant manta ray is commercial fishing; the species is both targeted and caught as bycatch in a number of global fisheries throughout its range. Manta rays are particularly valued for their gill rakers, which are traded internationally. Demand for the gills of manta and other mobula rays has risen dramatically in Asian markets. With the expansion of the international gill raker market and increasing demand for manta ray products, estimated harvest of giant manta rays, particularly in many portions of the Indo-Pacific, frequently exceed numbers of identified individuals in those areas and is accompanied by observed declines of up to 95% in sightings and landings of the species.

NMFS announced a final rule to list the giant manta ray as threatened on January 22, 2018 (83 FR 2916) throughout its range. In 2019, NMFS published the findings of a comprehensive review to evaluate the need to designate critical habitat for giant manta rays, concluding “a designation of critical habitat is not prudent at this time” (84 FR 66652).

3.2.1.2 Target Species

Target species are those fish which are managed under an FMP, commercially or recreationally fished, and for which stock assessments are conducted using NEFSC-affiliated fisheries research. The 2016 PEA (Table 3.2-1) identified 35 target species encountered during NEFSC-affiliated research activities (2008–2012) that were listed as overfished or subject to overfishing at that time, or for which the average annual research catch exceeded 2,200 pounds (1.1 ton or 1 mt). For the 2016 PEA, the 2,200 pound threshold served as a basis of comparison against the amount of commercial and recreational catch for the purposes of analysis. Since the 2016 PEA analysis, the list of fish has been expanded to include more species (i.e., species with research catch below the 2,200-pound threshold) or to break out specific stocks (i.e., windowpane flounder and yellowtail flounder) to provide a comprehensive evaluation of the potential effects of research on fish species. A complete table comparing research catch to commercial and recreational catch is provided in Appendix B. Table 3-4 below presents an update for those 35 species evaluated in the 2016 PEA in terms of status, abundance, or management since that time. Table 3-4 also indicates whether, based on any changes (or lack thereof), whether additional evaluation under the proposed SPEA alternatives is warranted. If a target species is considered depleted, overfished or if overfishing is occurring, a brief overview of key information regarding the species is summarized here and evaluation under the proposed SPEA alternatives is provided in Chapter 4. For example, while the status of Atlantic cod has not changed since the 2016 PEA, it is considered an overfished stock and therefore warrants evaluation under proposed NEFSC research alternatives proposed for the period 2021-2026 (see Chapter 4). If a stock has "unknown" status because additional information is not available, the evaluation from the 2016 PEA is still valid and those species are not discussed further.

TABLE 3-4. COMPARISON OF ASSESSMENT STATUS BETWEEN 2016 PEA AND THE SUPPLEMENTAL PEA FOR NEFSC TARGET FISH SPECIES

Target Fish	2016 PEA Section Reference	SPEA Evaluation Required? (Yes/No)	Stock Status Reported in 2016 PEA	Current Status	Reference
Acadian redfish	3.2.1.2	No	Not overfished-Rebuilt	No change in status.	NMFS (2017a); NMFS (2019)
Alewife (River herring)	3.2.1.2	Yes	Unknown	No change in status. In June 2019, NMFS completed a status review under the ESA concluding that alewife and blueback herring do not warrant listing at this time (84 FR 28630). Depleted status for the coast-wide meta-complex.	84 FR 28630; 82 FR 38672; ASMFC (2017b)
American plaice	3.2.1.2	No	Not overfished-Rebuilding	Rebuilt	NMFS (2017a); NMFS (2019)
Atlantic cod	3.2.1.2	Yes	GB and GOM stocks Overfished/overfishing	According to the 2019 stock assessment, the Gulf of Maine stock is overfished and below the target biomass level.	NMFS (2017a)
Atlantic croaker	3.2.1.2	No	Unknown	No change in status.	ASMFC (2018a)
Atlantic halibut	3.2.1.2	Yes	Overfished/no overfishing	No change in status. Populations have been increasing, overfishing is not occurring	NEFMC (2017); Trzcinski and Bowen (2016) Rago (2017)
Atlantic herring	3.2.1.2	Yes	Not overfished	Potential change in status; approaching overfished.	NEFSC (2018b) NEFMC (2018)
Atlantic mackerel	3.2.1.2	Yes	Unknown	Change in status. Overfished and overfishing is occurring.	NEFSC (2018a); NMFS (2019)
Atlantic wolffish	3.2.1.2	Yes	Overfished/no overfishing	No change in status.	NMFS (2017a); NMFS (2019)
Barndoor skate	3.2.1.2	No	Not overfished	No change in status. Currently a prohibited species in U.S. waters while the biomass is recovering from previous overfished condition.	NMFS (2019)
Black sea bass	3.2.1.2	No	Not overfished	No change in status.	NMFS (2017a); NEFSC (2019a)

Target Fish	2016 PEA Section Reference	SPEA Evaluation Required? (Yes/No)	Stock Status Reported in 2016 PEA	Current Status	Reference
Blueback herring (River herring)	3.2.1.2	No	Unknown	No change in status. In June 2019, NMFS completed a status review under the ESA concluding that alewife and blueback herring do not warrant listing at this time (84 FR 28630).	84 FR 28630; 82 FR 38672; ASMFC (2017b)
Bluefish	3.2.1.2	No	Not overfished	No change in status.	NMFS (2019)
Butterfish	3.2.1.2	No	Not overfished	No change in status.	Adams (2018); NMFS (2019)
Clearnose skate	3.2.1.2	No	Not overfished	No change in status.	NMFS (2019)
Goosefish (Monkfish)	3.2.1.2	No	Not overfished-Rebuilt	No change in status.	NEFSC (2013); NMFS (2019)
Haddock	3.2.1.2	No	GB stock: not overfished GOM stock: approaching overfished	No change in status, GB stock. Change in status, GOM stock no longer approaching overfished.	NMFS (2017a); NMFS (2019)
Little skate	3.2.1.2	No	Not overfished	No change in status.	NMFS (2019)
Ocean pout	3.2.1.2	Yes	Overfished/no overfishing	No change in status; continue rebuilding.	NMFS (2017a); NMFS (2019)
Pollock	3.2.1.2	No	Not overfished	No change in status.	NMFS (2017a); NMFS (2019)
Red hake	3.2.1.2	Yes	Not overfished	Change in status. Overfished and overfishing is occurring.	Alade and Traver (2018); NMFS (2019)
Scup	3.2.1.2	No	Not overfished	No change in status.	NMFS (2017b)
Silver hake (whiting)	3.2.1.2	No	Not overfished-Rebuilt	No change in status.	Alade and Traver (2018); NMFS (2019)
Spiny dogfish	3.2.1.2	No	Not overfished	No change in status.	NEFSC (2018d); NMFS (2019)
Spot	3.2.1.2	No	Unknown	No change in status.	ASMFC (2017a)
Striped bass	3.2.1.2	Yes	Not overfished-Rebuilt	Based on a 2019 status review NEFSC concluded that the striped bass stock is overfished and experienced overfishing in 2017.	NEFSC (2019a)

Target Fish	2016 PEA Section Reference	SPEA Evaluation Required? (Yes/No)	Stock Status Reported in 2016 PEA	Current Status	Reference
Summer flounder (fluke)	3.2.1.2	No	Not overfished	Based on a 2019 status review NEFSC concluded that the summer flounder stock is neither overfished nor did it experience overfishing in 2017.	NEFSC (2019a)
Thorny skate	3.2.1.2	Yes	Overfished/ no overfishing	No change in status. ESA status review published on February 24, 2017 concluded the thorny skate is not in danger of extinction and listing is not warranted.	82 FR 11540; NMFS (2017c)
Weakfish	3.2.1.2	Yes	Unknown	Change in status. Stock is now considered depleted[1].	ASMFC (2016)
White hake	3.2.1.2	No	Not overfished- rebuilding	Overfished	NMFS (2017a)
Windowpane flounder (sand dab)	3.2.1.2	Yes	GB & GOM: Overfished/overfishing SNE & MAB: not overfished	Change in status in 2015 from overfishing to no overfishing. No allocations for northern or southern stocks; possession is prohibited.	NMFS (2017a); NEFSC (2019a)
Winter flounder (blackback)	3.2.1.2	Yes	GB stock: Not overfished; rebuilt. GOM stock: Unknown. SNE/MAB stock: Overfished	GB stock overfished Others: No change in status.	NMFS (2017a); NEFSC (2019a)
Winter skate	3.2.1.2	No	Not overfished.	No change in status.	NMFS (2017a); NMFS (2019)
Witch flounder (grey sole)	3.2.1.2	Yes	Northwest Atlantic Coast stock: Overfished/ overfishing SNE/MAB stock: Overfished/ no overfishing	Potential change in status. Overfishing is currently unknown.	NMFS (2017a); NEFSC (2019a)

Target Fish	2016 PEA Section Reference	SPEA Evaluation Required? (Yes/No)	Stock Status Reported in 2016 PEA	Current Status	Reference
Yellowtail flounder	3.2.1.2	Yes	Cape Cod/GOM and GB stocks overfished. SNE/MAB stock is not overfished.	CC/GOM - Not overfished, overfishing not occurring, rebuilding. SNE – overfishing not occurring.	NEFSC (2019a)

[1] ASMFC (2016) indicates weakfish has been depleted for the past 13 years. A fish stock is considered depleted when it falls below a spawning stock biomass threshold of 30%.

3.2.1.2.1 Target Species With a Change in Status Since the 2016 PEA

Of the 35 target species identified in the 2016 PEA, five species/stocks have changed from a ‘not overfished’ or ‘unknown’ status prior to 2016, to an ‘overfished’ or ‘depleted’ status in more recent assessments. The Cape cod/GOM and GB stocks of yellowtail flounder have also changed from being designated as ‘overfished’ in 2016, to now being considered ‘not overfished and rebuilding. In addition to species-specific updates provided below, on July 19, 2019, NMFS published a final rule to set 2019–2020 catch limits for 7 of the 20 multispecies (groundfish) stocks, implements new or revised rebuilding plans for 5 stocks, revises an accountability measure, and makes other minor changes to groundfish management measures (84 FR 34799). The 2019 catch limits for GB cod, GOM cod, GB haddock, GB yellowtail flounder, witch flounder, GB winter flounder, GOM winter flounder, and Atlantic halibut changed under Framework 58. In fishing year 2017, the GOM cod ACL was exceeded and Framework 58 implemented a pound-for-pound reduction required for sectors and the common pool to address the overage of catch. Catch limits for GB cod, GB haddock, witch flounder, and GB winter flounder increased, and catch limits for GOM cod, GB yellowtail flounder, GOM winter flounder, and Atlantic halibut decreased. There were no changes for the remaining 12 stocks under Framework 58 (84 FR 34799). Rebuilding programs for GB winter flounder and northern windowpane flounder; and new rebuilding plans for SNE/MA yellowtail flounder, witch flounder and ocean pout (84 FR 34799).

The following summaries provide an overview of key information regarding the 15 species evaluated in Chapter 4 of this SPEA (as indicated in Table 3-4).

Alewife (River Herring)

A status review completed in 2017 reported that the coastwide meta-complex of river herring stocks on the U.S. Atlantic coast remains depleted to near historic lows. A depleted status indicates that there was evidence for declines in abundance due to a number of factors, but the relative importance of these factors in reducing river herring stocks could not be determined (ASMFC 2017b). For the period 2005-2015, the total annual incidental catch of alewife ranged from 36.5-531.7 mt in New England and 10.9-295.0 mt in the Mid-Atlantic. Paired midwater trawls and bottom trawls were the dominant gear during that time frame (ASMFC 2017b).

Atlantic Cod

According to a 2017 stock assessment, both stocks (GOM and GB) are overfished and overfishing is occurring. Total catch for 2017 was estimated at 428 mt and was projected to be 855 mt in 2020 assuming a harvest scenario at $F_{40\%}$ (F_{MSY} proxy) (NMFS 2017a). There is uncertainty regarding the estimate of natural mortality and a recent report indicated that commercial landings from the GOM may have been underestimated (Palmer 2017 as cited in (NMFS 2017a)). Population projections for the GOM stock, however, are fairly well determined and indicate is not on target to rebuild by 2024 (NMFS 2017a). Due to the lack of biological reference points for the GB stock of Atlantic cod, stock status cannot be quantified. The GB stock is considered overfished based on qualitative assessment but whether overfishing is occurring is still unknown. The GB stock appears to be in poor condition and continues to show a truncated age structure (NMFS 2017a).

Atlantic Halibut

Halibut are in a rebuilding program with a target completion year of 2056. Available data suggest that encounter rates in nontargeted fisheries are increasing and the stock of Atlantic halibut in U.S. waters is increasing. Although fishery-independent surveys weakly support this hypothesis, none of the current trawl surveys are efficient at capturing halibut. Rapid changes observed in the Canadian stock provide compelling evidence that support the concept the stock is increasing. Large changes in targeted longline surveys and Canadian trawl surveys (which have low capture efficiency similar to U.S. bottom trawl surveys) have occurred (Rago 2017).

Atlantic Herring

According to the August 2018 stock assessment report (NEFSC 2018b), the GOM/GB Atlantic herring complex is composed of several spawning aggregations. However, fisheries and research surveys catch fish from a mix of the spawning aggregations and methods to distinguish fish from each aggregation are not yet well established. Therefore, recent assessments have combined data from all areas and conducted a single assessment of the entire complex. Catch limits are still allocated however, to specific management areas (Correia 2012 as cited in (NEFSC 2018b)). Total biomass in 2017 was 239,470 mt (NEFSC 2018b).

Atlantic Mackerel

According to the 2018 stock assessment (NEFSC 2018a) Atlantic mackerel are overfished and are subject to overfishing. Atlantic mackerel previously had an unknown status, but the 2018 stock assessment indicated the stock has been overfished for nearly a decade.

Atlantic Wolffish

Catch has been limited almost exclusively to discards since the implementation of the no possession rule in May 2010 which causes discards to represent the only source of fishing mortality. No age-1 recruits have been caught in the NEFSC spring survey since 2004. Due to an increase in linear mesh size in 2009, the surveys may have reached the limit in detectability for wolffish (NMFS 2017a).

Ocean Pout

Despite low catch levels, the stock has not increased. Discards comprise the majority of the catch since a no possession regulation in 2010. There are few large fish in the population and the stock remains in poor condition (NMFS 2017a).

Red Hake

A 2017 stock assessment by Alade and Traver (2018) recommended that red hake be classified as overfished and that overfishing is occurring. The change in status is attributed to continued poor condition of the stock. The updated assessment reported the annual exploitation ratio for northern red hake at 55% (0.09 kt/kg) of the overfishing threshold (0.163 kt/kg). In the south, the annual exploitation ratio was 4.13 kt/kg, which was 32% above the overfishing proxy threshold (3.04 kt/kg). Commercial landings for red hake in recent years and in 2016 total landings increased by 52% in the north (140 mt) and declined by 10.7% in the south (392 mt). For northern red hake, large- and small-mesh trawls accounted for 45 to 50% of discards in 2015; in 2016, the small-mesh trawls dominated, contributing approximately 72% of the total red hake discards (Alade and Traver 2018). Recreational catches of red hake in the north

declined by 16%, from 3.5 mt in 2013 to 2.9 mt in 2016. In the south, however, recreational catches in 2016 almost doubled, from 68 mt in 2013 to 130 mt.

Striped Bass

In 2017, the Atlantic striped bass stock was overfished and experiencing overfishing relative to the updated reference points defined in the 2018 assessment (NEFSC 2019a). The overall population has been declining since about 2003. Commercial quota was reduced beginning in 2015 in response to a 2013 benchmark assessment. Landings averaged 2,133 mt (4.7 million pounds) from 2015–2017 (NEFSC 2019a).

Thorny Skate

Thorny skate abundance in U.S. waters is measured through NEFSC bottom trawl surveys which have been conducted in the fall from the GOM to Southern New England since 1963 and during the spring since 1968. While abundance decreased between 1977 and 2015, the 2015 estimate is considered stable and is comparable to the abundances observed during the early 1970s (ICES 2015 as cited in 82 FR 11540). The fall 2015 survey estimated 8,440 mt and 6 million fish within U.S. waters surveyed by NEFSC (Sosebee *et al*. in prep as cited in 82 FR 11540). On May 28, 2015, NMFS received a petition to list a Northwest Atlantic DPS of thorny skate as threatened or endangered under the ESA, or, as an alternative, a ‘‘U.S. DPS’’ as threatened or endangered. The petition also requested NMFS designate critical habitat for thorny skate. In response to the petition to list the species, NMFS published a determination on February 24, 2017 stating that thorny skate is not in danger of extinction and does not warrant listing under the ESA (82 FR 11540). NMFS also determined that neither thorny skates in the U.S. nor in the Northwest Atlantic are discrete from thorny skates throughout the rest of the North Atlantic due to genetic continuity, lack of differences in exploitation or management of habitat. Therefore, NMFS did not identify specific DPSs for thorny skate (83 FR 11540).

Weakfish

In the 2016 PEA the status of this stock was unknown. However, the results of the 2016 assessment show that the weakfish stock is depleted and has been for the past 13 years (ASMFC 2016). Weakfish commercial landings have dropped dramatically from over 19 million pounds landed in 1982 to roughly 200,000 pounds landed in 2014. Natural mortality has been increasing since the mid-1990s from approximately 0.16 to 0.93 from 2007-2014. Therefore, even though fishing mortality has been at low levels in recent years, the weakfish population has been experiencing very high levels of total mortality which has prevented the stock from recovering (ASMFC 2016).

Windowpane Flounder, *GOM/GB stock*

Stock status has not changed for GOM/GB windowpane flounder but in 2015, the stock went from overfishing to no overfishing. Although the estimated catch has declined recently, an increase in the survey index has not been evident despite an apparent increase in recruitment. Since the 2010 no possession rule, almost 100% of catch has consisted of discards. The stock was projected to be rebuilt by 2017 however, still remains below the biomass threshold (NMFS 2017a).

Winter Flounder, SNE/MAB stock

According to the 2019 stock assessment, the Georges Bank stock is overfished, remains in a rebuilding plan, and is not subject to overfishing (NEFSC 2019a). NMFS (2017a) estimated the spawning stock biomass of the SNE/MAB stock of winter flounder to be 4,360 mt in 2016 which is 18% of the target (24,687 mt) and 35% of the threshold for an overfished stock. The longevity of winter flounder is not well understood and leads to uncertainty about natural mortality. As a result, the effects of fishing mortality on biomass are also uncertain. The stock is in a rebuilding state with a rebuild date of 2023 though the 2017 operational assessment published by NMFS (2017a) reported less than 1% chance of reaching that target.

Witch flounder

Witch flounder is classified as an overfished stock, however, whether overfishing is occurring is currently unknown (NEFSC 2019a). Exploitable biomass in 2016 was estimated to be 14,563 mt. Allegations of commercial catch misreporting are currently under litigation and leads to uncertainty about catch rates. Stock condition remains poor as indicated by a reduction in the number of older fish reported in landings. (NMFS 2017a), reported minimum scientific research removals between 0.1 and 15.9 mt, with an average of 1 mt between 1963 and 2016.

Yellowtail Flounder *all stocks*

Based on the 2019 stock assessment, the Cape Cod/GOM stock is not overfished but still rebuilding to the target level, and not subject to overfishing. The SNE stock is considered overfished but overfishing is not occurring (NEFSC 2019a). Finally, the GB stock is overfished and subject to overfishing according to the 2013 stock assessment (NEFSC 2019a). The 2017 stock assessment reported that recent below average recruitment has resulted in declining spawning stock biomass. Spawning stock biomass for the SNE/MAB stock is projected to decrease in the short term, even at current level of catches (2016 catch was estimated to be the second lowest in the time series) (NMFS 2017a). Recruitment of SNE-MAB yellowtail flounder continues to be weak and if this pattern of poor recruitment continues into the future, the ability of the stock to recover could be compromised (NMFS 2017a).

3.2.1.3 Prohibited and Highly Migratory Species

HMS (Table 3-5) species migrate variable distances across oceans for feeding or reproduction and have wide geographic distributions. These pelagic species are typically found both within the 200-mile EEZ and in open oceans, although some life history stages may occur in nearshore waters. NEFSC and NEFSC-affiliated HMS research focuses on sharks. Atlantic HMS are managed under the 2006 Consolidated Atlantic HMS FMP and its amendments (NMFS 2020a). The most recent amendment to this FMP (Amendment 14) (NMFS 2020b) revised the general mechanisms used to establish quotas and related management measures for Atlantic shark fisheries. Amendment 14 does not make any changes to the current quotas or management measures, it only updates the approach taken to determine quotas. The amendment does promote implementation of scientific research programs that include the tagging and release of Atlantic HMS as practicable.

TABLE 3-5. DOMESTIC STATUS OF HIGHLY MIGRATORY SPECIES

Highly Migratory Species (HMS)	2016 PEA Section Reference	SPEA Evaluation Required? (Yes/No)	Current Status Since the 2016 PEA	Reference
Sharks				
Atlantic angel	3.2.1.3	No	Unknown	NMFS (2020a)
Dusky	3.2.1.3	Yes	Overfished; overfishing is occurring. December 7, 2014 status review and ESA determination that NW Atlantic population constitutes a DPS but did not warrant listing.	NMFS (2020a) McCandless *et al.* (2014); 79 FR 74684
Atlantic sharpnose	3.2.1.3	No	Not overfished	NMFS (2020a)
Basking	3.2.1.3	No	Unknown	NMFS (2020a)
Blacktip - Atlantic	3.2.1.3	No	Unknown status; Overfishing is not likely	NMFS (2020a)
Blue	3.2.1.3	No	Not overfished	NMFS (2020a)
Bigeye sand tiger	3.2.1.3	No	Unknown	NMFS (2020a)
Bigeye sixgill	3.2.1.3	No	Unknown	NMFS (2020a)
Bigeye thresher	3.2.1.3	No	Unknown	NMFS (2020a)
Bignose	3.2.1.3	No	Unknown	NMFS (2020a)
Blacknose	3.2.1.3	Yes	Overfished; overfishing is occurring	NMFS (2020a)
Bluntnose sixgill	3.2.1.3	No	Unknown	NMFS (2020a)
Bonnethead	3.2.1.3	No	Unknown	NMFS (2020a)
Bull	3.2.1.3	No	Unknown	NMFS (2020a)
Caribbean reef	3.2.1.3	No	Unknown	NMFS (2020a)
Caribbean sharpnose	3.2.1.3	No	Unknown	NMFS (2020a)
Finetooth	3.2.1.3	No	Not overfished	NMFS (2020a)
Galapagos	3.2.1.3	No	Unknown	NMFS (2020a)
Great hammerhead	3.2.1.3	No	Unknown; In response to a petition to list under ESA, NMFS determined that listing is not warranted.	NMFS (2020a) 79 FR 33509
Lemon	3.2.1.3	No	Unknown	NMFS (2020a)
Longfin mako	3.2.1.3	No	Unknown	NMFS (2020a)
Shortfin mako	3.2.1.3	Yes	Change in status since 2016. Overfished; overfishing is occurring	NMFS (2020a)
Narrowtooth	3.2.1.3	No	Unknown	NMFS (2020a)
Night	3.2.1.3	No	Unknown	NMFS (2020a)

Highly Migratory Species (HMS)	2016 PEA Section Reference	SPEA Evaluation Required? (Yes/No)	Current Status Since the 2016 PEA	Reference
Nurse	3.2.1.3	No	Unknown	NMFS (2020a)
Oceanic whitetip	3.2.1.3	Yes	Oceanic whitetip was listed as threatened under the ESA January 30, 2018. Critical habitat has not been designated.	NMFS (2020a) 83 FR 4153
Porbeagle	3.2.1.3	Yes	Overfished	NMFS (2020a)
Sandbar	3.2.1.3	Yes	Change in status since 2016. Overfished with no overfishing occurring (previously overfishing occurring)	NMFS (2020a)
Sand tiger	3.2.1.3	No	Unknown	NMFS (2020a)
Scalloped hammerhead	3.2.1.3	Yes	No change in status for the NW Atlantic and GOM DPS since 2016. Overfished; overfishing is occurring.	NMFS (2020a)
Sharpnose sevengill	3.2.1.3	No	Not overfished.	NMFS (2020a)
Silky	3.2.1.3	No	Unknown. In 2016, added to Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) Appendix II. Species listed in Appendix II are vulnerable to overexploitation but not at risk of extinction.	NMFS (2020a)
Smalltail	3.2.1.3	No	Unknown	NMFS (2020a)
Smoothhound	3.2.1.3	No	Commercial smoothhound shark vessel permits have been required since March 15, 2016 (80 FR 73128). Permits are open-access, and required to land and sell smoothhound sharks including smooth dogfish, Florida smoothhound, and gulf smoothhound.	NMFS (2020a)
Spinner	3.2.1.3	No	Unknown	NMFS (2020a)
Smooth Hammerhead	3.2.1.3	No	Unknown	NMFS (2020a)
Thresher	3.2.1.3	No	Unknown In 2016, added to Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) Appendix II. Species listed in Appendix II are vulnerable to overexploitation but not at risk of extinction.	NMFS (2020a)
Tiger	3.2.1.3	No	Unknown	NMFS (2020a)
Whale	3.2.1.3	No	Unknown	NMFS (2020a)

Highly Migratory Species (HMS)	2016 PEA Section Reference	SPEA Evaluation Required? (Yes/No)	Current Status Since the 2016 PEA	Reference
Tunas				
Albacore	3.2.1.3	No	Not overfished; rebuilt. October 11, 2018, NMFS published a final rule that increased baseline annual U.S. bluefin tuna quota from 1,058.79 mt whole weight (ww) to 1,247.86 mt ww and increased baseline annual U.S. North Atlantic northern albacore quota from 527 mt ww to 632.4 mt ww to reflect quotas adopted by ICCAT (83 FR 51391).	NMFS (2020a) 83 FR 51391
Bigeye	3.2.1.3	Yes	Overfished internationally, not in domestic waters	NMFS (2020a)
Bluefin	3.2.1.3	No	Overfished status unknown; overfishing is not occurring See albacore tuna above.	NMFS (2020a)
Yellowfin	3.2.1.3	No	Overfished internationally, not in domestic waters	NMFS (2020a)
Skipjack	3.2.1.3	No	Not overfished	NMFS (2020a)
Other Species				
Swordfish	3.2.1.3	No	Not overfished (North Atlantic);	NMFS (2020a)
Blue Marlin	3.2.1.3	Yes	A new assessment is complete however domestic status has yet to be determined at the time of this publication.	NMFS (2020a)
Longbill spearfish	3.2.1.3	No	Unknown	NMFS (2020a)
Sailfish	3.2.1.3	No	Not overfished, rebuilding	NMFS (2020a)
White marlin	3.2.1.3	Yes	Overfished; overfishing is not occurring	NMFS (2020a)

Since publication of the 2016 PEA, Amendments 9 - 14 were implemented or published as follows:

- Amendment 9: Atlantic Shark Management Measures (Final Rule November 24, 2015; 80 FR 73128);
- Amendment 10: Essential Fish Habitat (Final Rule September 6, 2017; 82 FR 42329);
- Amendment 11: Atlantic Shortfin Mako Sharks (Final Rule March 3, 2019; 84 FR 5358);
- Amendment 12: MSA Guidelines and National Policy Directives (Notice of Intent [NOI] September 3, 2019; 84 FR 45941);
- Amendment 13: Bluefin Management Measures (NOI May 21, 2019; 84 FR 23020); and
- Amendment 14: Shark Quota Management (NOI May 20, 2019; 84 FR 23014); Draft Amendment published September 2020(NMFS 2020b).

In addition, on November 27, 2018, NMFS published a final rule (83 FR 60777) that established quotas, opening dates, and retention limits for the 2019 Atlantic large coastal shark (LCS) and hammerhead commercial shark fisheries. Quota adjustments were based on harvest rates during the 2018 fishing year (NMFS 2020a).

The following summaries provide an overview of key information regarding 9 of the 10 species evaluated in Chapter 4 of this SPEA (as indicated in Table 3-5). For information on the oceanic whitetip shark see Section 3.2.1.1.

3.2.1.3.1 Dusky Shark

Based on the SEDAR 21 assessment, the U.S. Atlantic stock of dusky sharks are overfished and experiencing overfishing (SEDAR 2011). In 2016, an update to this assessment was published incorporating more recent data (i.e. 2010-2015) (SEDAR 2016). The stock status remains unchanged (NMFS 2020a). Dusky sharks have been prohibited from retention in U.S. fisheries since 2000. Following the assessment update, NMFS implemented additional management measures to reduce fishing mortality on the stock and rebuild the dusky shark population (82 FR 16478, April 4, 2017). These included the adoption of shark release protocols for the HMS pelagic longline fishery; circle hook requirement in the directed shark bottom longline fishery; and dusky shark identification and safe handling training, as well as outreach and fleet communication protocols in the HMS pelagic longline, bottom longline, and shark gillnet fisheries.

3.2.1.3.2 Blacknose Shark

The blacknose shark was last assessed through the Southeast Data and Review (SEDAR) process in 2010 (SEDAR 2011) resulting in an overfished status with overfishing occurring. To end overfishing and rebuild the blacknose shark stock, Amendment 3 in 2010 established a separate quota of 19.9 mt dressed weight (dw) for blacknose sharks and reduced the small coastal shark (SCS) quota for the remaining non-blacknose SCS to 221.6 mt dw. If one of these quotas was reached or exceeded, then both would close. (NMFS 2020a)reported a total of 7.82 mt dw of blacknose sharks landed in 2017 by commercial fisheries in the Atlantic Region. In 2017, the establishment of an eight shark trip limit for this species aimed to minimize the occurrence of early closures, allowing for full utilization of the commercial non-blacknose SCS quota (NMFS 2020a).

3.2.1.3.3 Shortfin Mako

In 2017, ICCAT conducted a benchmark assessment of the North Atlantic shortfin mako stock and determined that the stock to be overfished with overfishing occurring. In 2017, the total U.S. landings of shortfin mako were 296 individuals while there were four individuals reported as dead discards. In the international waters of the North Atlantic, 3,107 sharks were landed and five sharks were reported as dead discards; therefore, the U.S. represented 9.6 percent of total landings reported to ICCAT in the North Atlantic in 2017 (NMFS 2020a). Based on the results of the ICCAT assessment, NMFS implemented emergency management measures in 2018 to reduce shortfin mako landings in commercial and recreational fisheries, with retention allowed only in certain limited circumstances (83 FR 8946) and extended these measures while developing long-term measures consistent with ICCAT recommendations (83 FR 42452). In 2019, NMFS amended the Consolidated Atlantic HMS Fishery Management Plan (Final Amendment 11) to include management measures that will reduce fishing mortality on shortfin mako sharks and establish the foundation for rebuilding the population consistent with legal requirements (84 FR 5358).

3.2.1.3.4 Porbeagle

North Atlantic Porbeagle were assessed in 2005 by the Canadian Department of Fisheries and Oceans. NMFS determined that because the stock is a unit stock that extends into U.S. waters, the assessment and its recommendations were appropriate for use in U.S. domestic management. In 2008, NMFS established a 100-year rebuilding plan for porbeagle sharks based on this assessment so that the population is expected to be rebuilt by 2108 (73 FR 35777, 73 FR 40657). In 2009, the International Commission for Conservation of Atlantic Tunas (ICCAT) Standing Committee on Research and Statistics (SCRS) published an assessment of Porbeagle sharks (*Lamna nasus*) that updated the Canadian assessment stating that while the Northwest Atlantic stock is increasing in biomass, the stock is still considered to be overfished with overfishing not occurring. In 2016, NMFS published a final rule implementing the ICCAT recommendation that porbeagles caught in association with ICCAT fisheries be promptly released unharmed, to the extent practicable, when brought alive alongside the vessel during haulback (81 FR 57803). In the U.S., only 8 mt wet weight (ww) of porbeagle were landed and 6 mt ww were discarded dead in 2017 (NMFS 2020a).

3.2.1.3.5 Sandbar Shark

The 2006 LCS assessment, conducted according to the SEDAR process, indicated that sandbar sharks were overfished and overfishing was occurring (71 FR 65086). In response to this assessment, NMFS amended the Consolidated Atlantic HMS Fishery Management Plan (Final Amendment 2) to incorporate management measures to rebuild the population and prevent overfishing, including: reductions in quota, the establishment of a shark research fishery, limiting commercial retention of sandbar sharks to participants in the shark research fishery, and prohibiting the retention of sandbar sharks in the recreational fishery (73 FR 35777, 73 FR 40657). SEDAR published an assessment in 2011 that resulted in an overfished status with overfishing no longer occurring for the sandbar shark (SEDAR 2011). The most recent assessment (NMFS 2020a)also resulted in an overfished status, and still no overfishing occurring. The strict limitation on catches in recent years has ended overfishing. Only 21 mt dw of

sandbar sharks were landed in 2017 and all were retained during the shark research fishery, which is the only fishery allowed to retain sandbar sharks at this time (NMFS 2020a).

3.2.1.3.6 Scalloped Hammerhead

Hayes *et al.* (2009) published a stock assessment of the U.S. Atlantic population of scalloped hammerhead in the North American Journal of Fisheries Management. NMFS reviewed this assessment and concluded that it was complete, it was an improvement over a 2008 aggregated assessment for hammerhead species, and the assessment is appropriate for U.S. management decisions. Based on the results of the Hayes *et al.* (2009) assessment, NMFS determined in 2011 that scalloped hammerhead sharks are overfished and experiencing overfishing (76 FR 23794). Following this determination, NMFS amended the Consolidated Atlantic HMS Fishery Management Plan (Final Amendment 5a) in 2013 to incorporate management measures to rebuild the population and prevent overfishing, including: the establishment of a new hammerhead shark (great, scalloped, smooth) management group with regional quotas, the establishment of regional quota linkages, and an increase the recreational size limit for all hammerhead sharks (78 FR 40317). Only 2.23 mt dw of scalloped hammerhead were landed in commercial fisheries in 2017 (NMFS 2020a).

3.2.1.3.7 Bigeye Tuna

Based on a 2018 stock assessment, the stock is considered overfished and overfishing is occurring. ICCAT did not initially agree on conservation and management measures to end overfishing or implementation of a rebuilding plan for bigeye tuna. The U.S. advocated for a total allowable catch to end overfishing within two years and rebuild the stock within ten years. After further consideration, ICCAT adopted Recommendation 18-01 through 2018 for bigeye tuna, which extended existing management measures, including the quota table from Recommendation 16-01. ICCAT did, however, suspend paragraph 2(a) of Recommendation 16-01, related to payback of total allowable catch overages, and the Ghanaian payback provisions adopted in 2011.

3.2.1.3.8 Blue Marlin

The ICCAT SCRS completed a stock assessment for blue marlin in 2018 which found the stock to be overfished with overfishing occurring (NMFS 2020a). To extend management measures originally described in Recommendation 15-05 for one year, ICCAT adopted Recommendation18-04 and planned to revisit management measures in 2019. Since 2008, an average of 262 HMS tournaments have registered each year. The number of HMS 2018 tournaments registered as of October 31, 2018 is below this average at 246 tournaments. The largest number of HMS tournament registrations for a given year was received in 2017 (n=287). Total U.S. recreational landings and commercial dead discards of Atlantic blue marlin in 2017 were 13 and 46 individual marlin (respectively). Atlantic HMS tournaments are also evaluated in cumulative effects Chapter 5. In the international waters of the Mediterranean Sea, ICCAT SCRS (2018 as reported in (NMFS 2020a). NMFS (2020a) reported a total of 1,888 landings and 99 dead discards from the pelagic longline and purse seine fisheries. Therefore, U.S. landings and dead discards accounted for three percent of total catch (U.S. and international combined) (NMFS 2020a).

3.2.1.3.9 White Marlin

The 2019 SAFE Report (NMFS 2020a) reported the BMSY for white marlin (and roundscale spearfish) as 29,240 mt. White and blue marlin remain one of the most sought after species for recreational HMS tournaments with over 45 percent of HMS tournaments for the period 2015-2017 (262 and 287 tournaments, respectively) including these two species (NMFS 2020a). Total U.S. recreational landings and commercial dead discards of Atlantic white marlin in 2017 were two and five individual marlin (respectively). ADD statement about number of tournaments. In the international waters of the Mediterranean Sea, ICCAT SCRS (2018 as reported in (NMFS 2020a)) reported a total of 395 landings and seven dead discards from the pelagic longline and purse seine fisheries. Therefore, U.S. landings and dead discards accounted for 1.7 percent of total catch (U.S. and international combined) (NMFS 2020a).

3.2.1.4 Other Species

Fish species in this section include target species that are infrequently encountered in NEFSC research surveys, and other species that are not managed under an FMP but may be caught on a regular basis during NEFSC fisheries research surveys. Table 3-6 provides an update on the current status of these species since the 2016 PEA. Current species status is based on the most recent SAFE reports and other sources as shown in the References column in Table 3-6. While Table 3-6 does not provide a complete list of all species that have ever been caught in NEFSC surveys in the past, it is representative of the range species that fall into this category. If a species is considered depleted, overfished or if overfishing is occurring, or is an ESA candidate or listed species, a brief overview of key information regarding the species is summarized here and evaluation under the proposed SPEA alternatives is provided in Chapter 4. If a stock has "unknown" status because additional information is not available, the evaluation from the 2016 PEA is still valid and those species are not discussed further. As indicated in Table 3-6, while American eel are considered depleted in the U.S., NEFSC has not reported bycatch of this species for over 10 years. Therefore, analysis under the SPEA alternatives is not warranted. Additionally, while cusk was listed in 2007 as an ESA Candidate Species, the low average NEFSC research catch of this species does not warrant additional review under the SPEA alternatives.

TABLE 3-6. COMPARISON OF STOCK ASSESSMENTS BETWEEN 2016 PEA AND 2019 SUPPLEMENTAL PEA – OTHER SPECIES ENCOUNTERED BY NEFSC RESEARCH SURVEYS

Species	2016 PEA Section Reference	SPEA Evaluation Required? (Yes/No)	Current Status compared to 2016 PEA	Reference
American eel	3.2.1.4	No	No change in status - While American eel are considered depleted in the U.S., NEFSC has not reported bycatch of this species for over 10 years. Therefore, analysis under the SPEA alternatives is not warranted.	Tuckey and Fabrizio (2019)
American shad	3.2.1.4	No	No change in status - unknown. Stock assessment initiated in 2017.	ASMFC (2019d)
Atlantic hagfish (slime eel)	3.2.1.4	No	No change in status or unknown	Froese and Pauly (2019)
Atlantic menhaden	3.2.1.4	No	No change in status	SEDAR (2020)
Bay anchovy	3.2.1.4	No	No change in status	Tuckey and Fabrizio (2019)
Bluntnose stingray	3.2.1.4	No	No change in status	Froese and Pauly (2019)
Bullnose ray	3.2.1.4	No	No change in status	Froese and Pauly (2019)
Cownose ray	3.2.1.4	No	No change in status	Froese and Pauly (2019)
Cusk	3.2.1.4	No	No change in status. While cusk was listed in 2007 as an ESA Candidate Species, the low average NEFSC research catch of this species does not warrant additional review under the SPEA alternatives.	Froese and Pauly (2019)
Four spotted flounder	3.2.1.4	No	No change in status	Bigelow and Schroeder (2002)
Golden tilefish	3.2.1.4	No	No change in status	NEFSC (2014)
Kingfish spp. (*Menticirrhus*)	3.2.1.4	No	No change in status	NEFSC (2019a)
Longhorn sculpin	3.2.1.4	No	No change in status	Link and Almeida (2002)
Northern sand lance	3.2.1.4	No	No change in status	Froese and Pauly (2019)
Northern sea robin	3.2.1.4	No	No change in status	
Offshore hake	3.2.1.4	No	No change in status	Alade and Traver (2018)
Red drum	3.2.1.4	No	No change in status	ASFMC (2017)
Roughtail stingray	3.2.1.4	No	No change in status	Froese and Pauly (2019)

Species	2016 PEA Section Reference	SPEA Evaluation Required? (Yes/No)	Current Status compared to 2016 PEA	Reference
River herring[1]	3.2.1.4	Yes (Section 3.2.1.2)	No change in status – Depleted	ASMFC (2017b)
Round herring	3.2.1.4	No	No change in status	Froese and Pauly (2019)
Sea raven	3.2.1.4	No	No change in status	Froese and Pauly (2019)
Spanish mackerel	3.2.1.4	No	No change in status	Froese and Pauly (2019)
Spiny butterfly ray	3.2.1.4	No	No change in status	Froese and Pauly (2019)
Spotted hake	3.2.1.4	No	No change in status	Froese and Pauly (2019)
Spotted seatrout	3.2.1.4	No	No change in status	Froese and Pauly (2019)
Striped anchovy	3.2.1.4	No	No change in status	Froese and Pauly (2019)
Tautog	3.2.1.4	No	No change in status	Froese and Pauly (2019)

[1] River herring is a collective term for alewife (*Alosa pseudoharengus*) and blueback herring (*Alosa aestivalis*).

3.2.2 Marine Mammals

The marine mammal species listed in Table 3-7 that typically occur in the NE LME and in areas frequented by the NEFSC research surveys were described in Section 3.2.2, Table 3.2-4 and Appendix C of the 2016 PEA. As described in Section 1.2, concurrent with development of this SPEA, NEFSC is applying for regulations and a new five-year LOA for the incidental taking of marine mammals pursuant to Section 101(a)(5)(A) of the MMPA. In 2016, NMFS issued a 5-year LOA for fisheries and ecosystem research conducted by NEFSC. The new LOA would cover NEFSC's proposed research beginning in 2021 as described in Chapter 2 of this SPEA. For this reason, it is important to provide the most recent abundance estimates for marine mammals that may occur within the Project Area. Species presented in this section include both ESA-listed and non-ESA listed marine mammals that could be taken by "harassment" during the course of NEFSC fisheries and ecosystem research planned for the period 2021-2026. The survey areas may also overlap with designated critical habitat for ESA-listed species as described in Chapter 3 of the 2016 PEA.

Information provided here is based on published literature, reports or observer data and summarizes stock status, abundance / density, distribution and habitat. Table 3-7 provides abundance estimates for species that may occur in the NE LME. Based on the 2018 stock assessment reports (SAR) (Hayes *et al.* 2019), abundance estimates for some marine mammal stocks have changed since the 2016 PEA as shown in Table 3-7. For most species, changes in abundance are relatively small and for that reason, proposed fisheries and ecosystem research-related impacts are not expected to result in a different conclusion than was described in the 2016 PEA. In many cases, adjustments to species' abundance as reported in the recent SAR are not the result of biologically significant changes associated with population demographics (reproduction rate, mortality, emigration or immigration, etc.). Rather, the differences between the more recent abundance estimates from those in 2016 are more likely the result of new or different datasets or assessment methods used. NMFS attempts to update the status of each marine mammal stock at least

TABLE 3-7. ABUNDANCE OF MARINE MAMMALS IN NEFSC RESEARCH AREAS

Marine Mammals	2016 PEA Section Reference	Abundance and Status[1] from 2016 PEA	Current Estimated Abundance[2]	Description	SPEA Evaluation Required? (Yes/No)
Cetaceans					
North Atlantic right whale	3.2.2	455 – E, D, S	412	January 27, 2016, NMFS designated 29,763 nm^2 of marine habitat in the GOM and Georges Bank and off the Southeast U.S. coast as critical habitat (81 FR 4837).	Yes
Humpback whale (GOM stock)	3.2.2	823 – E, D, S	1,393	Change in status; West Indies DPS (which is found in GOM) was delisted on September 8, 2016 (81 FR 62259).	Yes
Fin whale	3.2.2	3,522 – E, D, S	6,802	No change in status. However, population estimate differs by >10% from the 2016 PEA and will be discussed further	Yes
Sei whale (Nova Scotia Stock)	3.2.2	357 – E, D, S	6,292	No change in status.	No
Minke whale	3.2.2	20,741	21,968	No change in status. However, population estimate differs by >10% from the 2016 PEA and will be discussed further.	Yes
Blue whale	3.2.2	440[3] – E, D, S	402[3]	No change in status.	No
Sperm whale	3.2.2	2,288 – E, D, S	4,349	No change in status. Disturbance takes are authorized for offshore areas.	Yes
Pygmy sperm whale	3.2.2	3,785[4]	7,750[4]	No change in status. Takes are authorized for offshore areas but none are expected.	No
Dwarf sperm whale	3.2.2	3,785[4]	7,750[4]	No change in status. No takes occur or are authorized.	No
Killer whale (Western North Atlantic)	3.2.2	Unknown	Unknown	No change in status.	No
Pygmy killer whale (Western North Atlantic)	3.2.2	Unknown	Unknown	No change in status.	No

Marine Mammals	2016 PEA Section Reference	Abundance and Status[1] from 2016 PEA	Current Estimated Abundance[2]	Description	SPEA Evaluation Required? (Yes/No)
Northern bottlenose whale ***(Western North Atlantic)***	3.2.2	Unknown	Unknown	No change in status. Takes are authorized.	Yes
Cuvier's beaked whale	3.2.2	6,532	5,744	No change in status. However, population estimate differs by >10% from the 2016 PEA and will be discussed further. Takes are authorized.	Yes
Blainville's beaked whale	3.2.2	7,092[5]	10,107[5]	No change in status.	No
Gervais' beaked whale	3.2.2	7,092[5]	10,107[5]	No change in status.	No
Sowerby's beaked whale	3.2.2	7,092[5]	10,107[5]	No change in status.	No
True's beaked whale	3.2.2	7,092[5]	10,107[5]	No change in status.	No
Melon-headed whale	3.2.2	Unknown	Unknown	No change in status.	No
Risso's dolphin	3.2.2	18, 250	35,493	No change in status. Takes are authorized.	Yes
Long-finned pilot whale	3.2.2	26,535	39,215	No change in status. However, population estimate differs by >10% from the 2016 PEA and will be discussed further. Takes are authorized.	Yes
Short-finned pilot whale	3.2.2	21,515	28,924	No change in status. Takes are authorized	Yes
Atlantic white-sided dolphin	3.2.2	48,819	93,233	No change in status. Takes are authorized	Yes
White-beaked dolphin	3.2.2	2,003	5,478[6]	No change in status. Takes are authorized.	Yes
Short-beaked common dolphin	3.2.2	173,486	172,825	No change in status. Takes are authorized.	Yes
Atlantic spotted dolphin	3.2.2	44,715	39,921	No change in status. Takes are authorized.	Yes

Marine Mammals	2016 PEA Section Reference	Abundance and Status[1] from 2016 PEA	Current Estimated Abundance[2]	Description	SPEA Evaluation Required? (Yes/No)
Pantropical spotted dolphin	3.2.2	3,333	6,593	No change in status.	No
Striped dolphin	3.2.2	54,807	67,036	No change in status. Takes are authorized.	Yes
Fraser's dolphin	3.2.2	Unknown	Unknown	No change in status.	No
Rough-toothed dolphin	3.2.2	271	136	No change in status.	No
Clymene dolphin	3.2.2	Unknown	4,237	No change in status.	No
Spinner dolphin	3.2.2	Unknown	4,102	No change in status.	No
Bottlenose dolphin	3.2.2			No change to status; February 9, 2015 final rule required year-round use of modified pound net leaders for offshore Virginia pound nets within the Bottlenose Dolphin Pound Net Regulated Area and removed land-based inspection program for modified pound net leaders under ESA (80 FR 6925)	Yes
Migratory stocks, (Coastal LME)	3.2.2	11,548 Northern Migratory Coastal Stock - D, S	6,639	No change in status. However, the population estimates for both coastal stocks differ by >10% from the 2016 PEA and will be discussed further.	Yes
	3.2.3	9,173 Southern Migratory Coastal Stock – D, S	3,751		
Offshore stock, western North Atlantic	3.2.2	77,532[6]	62,851	No change in status. Takes are authorized.	Yes
Harbor porpoise (GOM/Bay of Fundy)	3.2.2	79,883	95,543	No change in status. Takes are authorized	Yes

Marine Mammals	2016 PEA Section Reference	Abundance and Status[1] from 2016 PEA	Current Estimated Abundance[2]	Description	SPEA Evaluation Required? (Yes/No)
Pinnipeds					
Harbor seal	3.2.2	70,142	75,834	No change in status. Takes are authorized.	Yes
Grey seal	3.2.2	Unknown	27,131	No change in status. However, population was not known at the time of the 2016 PEA and will be discussed further. Takes are authorized.	Yes
Harp seal	3.2.2	Unknown	Unknown	No change in status	No
Hooded seal	3.2.2	Unknown	Unknown	No change in status.	No

1 Abundance = N_{best} (if available) from SAR (2020) available at: https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessment-reports
2 E - Endangered, T - Threatened, D - Depleted, S - Strategic: ESA listing as either endangered or threatened, or MMPA listing as depleted. By default, all species listed under the ESA as threatened or endangered are also considered depleted under the MMPA. The term "strategic stock" under the MMPA means a marine mammal stock (a) for which the level of direct human-caused mortality exceeds the potential biological removal level; which, based on the best available scientific information is declining and is likely to be listed as a threatened species under the ESA; or (c) which is listed under the ESA. All marine mammals are protected under the MMPA.
3 N_{min} from 1980-2008 surveys
4 This estimate includes both the dwarf and pygmy sperm whales; June-Aug 2016 surveys central Florida to Bay of Fundy
5 This estimate includes all Mesoplodon species.
6 This includes only Bay of Fundy/Scotian Shelf.

every three years and more often for ESA-listed species or species considered 'strategic' under the MMPA. As stock assessments are revised, abundance estimates change. Generally, the Guidelines for Assessing Marine Mammal Stocks (GAMMS) II Workshop Report 2016 guidelines for preparing SARs (Wade and Angliss 1997, NEFSC and NMFS 2016) requires that survey results older than eight years are deemed unreliable.

Since 2016, abundance estimates have changed by >10% for seven species/stocks of whales/dolphins and one pinniped. In most cases, these adjustments to stock assessments are not due to biologically significant changes in population demographics (reproduction rate, mortality, emigration or immigration, etc). Rather, the differences between the more recent abundance estimates from those in 2016 are more likely the result of new datasets, new assessment methods, or different survey methods since 2016. NMFS publishes the status of each marine mammal stock in Stock Assessment Reports (SARs) every three years for non-strategic and every year for strategic stocks (ESA-listed species or species considered 'strategic' under the MMPA). As SARs are revised, abundance estimates change. Generally, the GAMMS II Workshop Report 2016 guidelines for preparing SARs (Wade and Angliss 1997, NEFSC and NMFS 2016) require that survey results older than eight years are deemed unreliable and are not used in decision-making. For purpose of this SPEA, estimates that have changed >10% are included for evaluation under the proposed future research alternatives but do not necessarily indicate a biologically significant change for the species or stock. The following information provides a brief overview of specific species changes (regulatory or in abundance).

3.2.2.1 North Atlantic Right Whale

On January 27, 2016, NMFS published a final rule designating two new areas as critical habitat for North Atlantic right whales (81 FR 4837). The areas included approximately 29,763 nm^2 of marine habitat in the Gulf of Maine and Georges Bank region (Unit 1; see Figure 3-2) and off the Southeast U.S. coast (Unit 2; see Figure 3-3). Physical and oceanographic features in GOM and Georges Bank combine to distribute and aggregate important prey species, *C. finmarchicus*, in Unit 1 while Unit 2 provides important calving area functions (81 FR 4837). As described in Wade and Angliss (1997), Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a recovery factor (MMPA Sec. 3. 16 U.S.C. 1362). The minimum population estimate for the Western Atlantic stock North Atlantic right whales is 412, (SAR 2020); therefore PBR is extremely low at 0.8 whales (Hayes *et al.* 2020, SAR 2020).

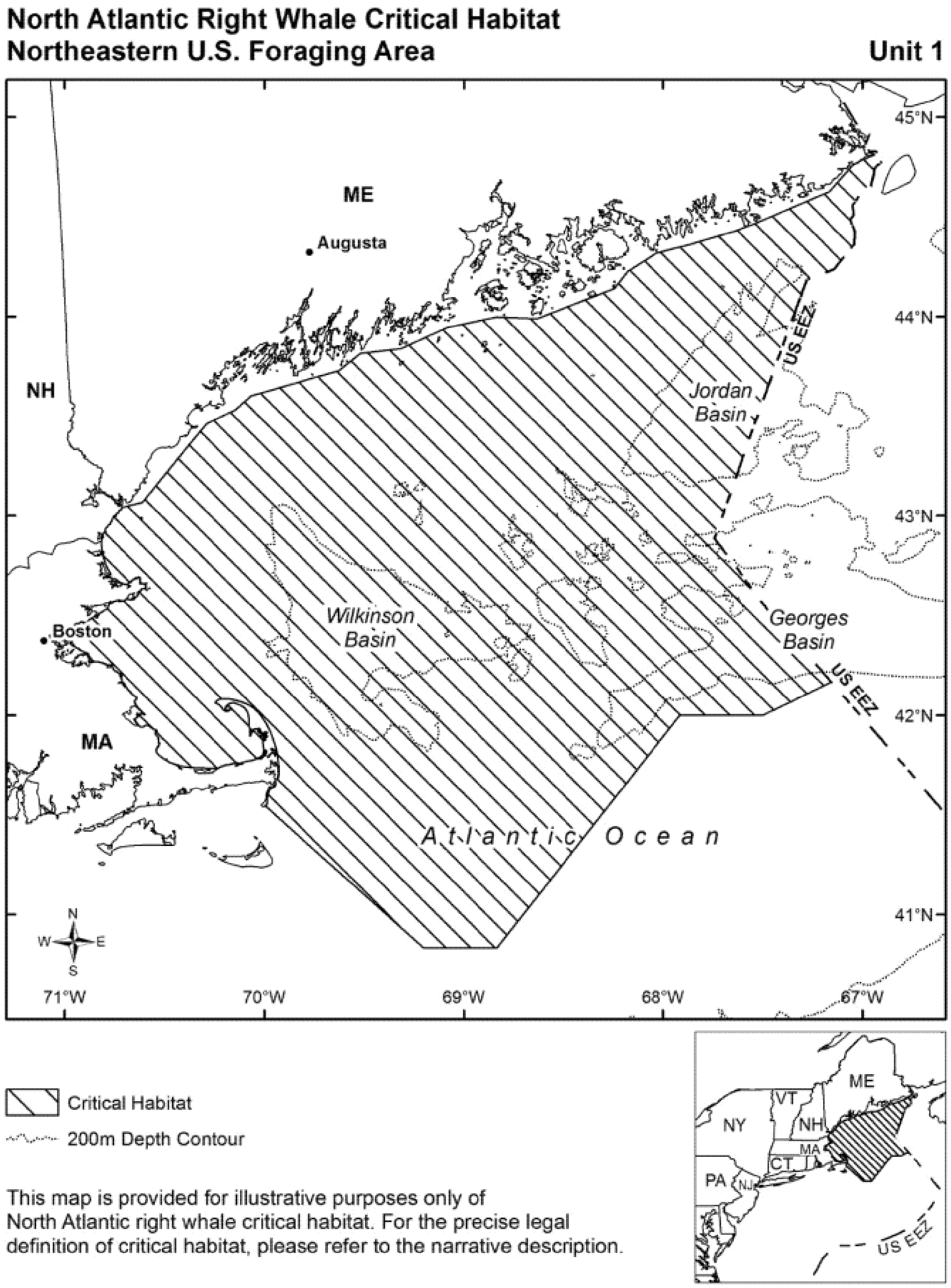


FIGURE 3-2. NORTH ATLANTIC RIGHT WHALE CRITICAL HABITAT UNIT 1: FORAGING CRITICAL HABITAT

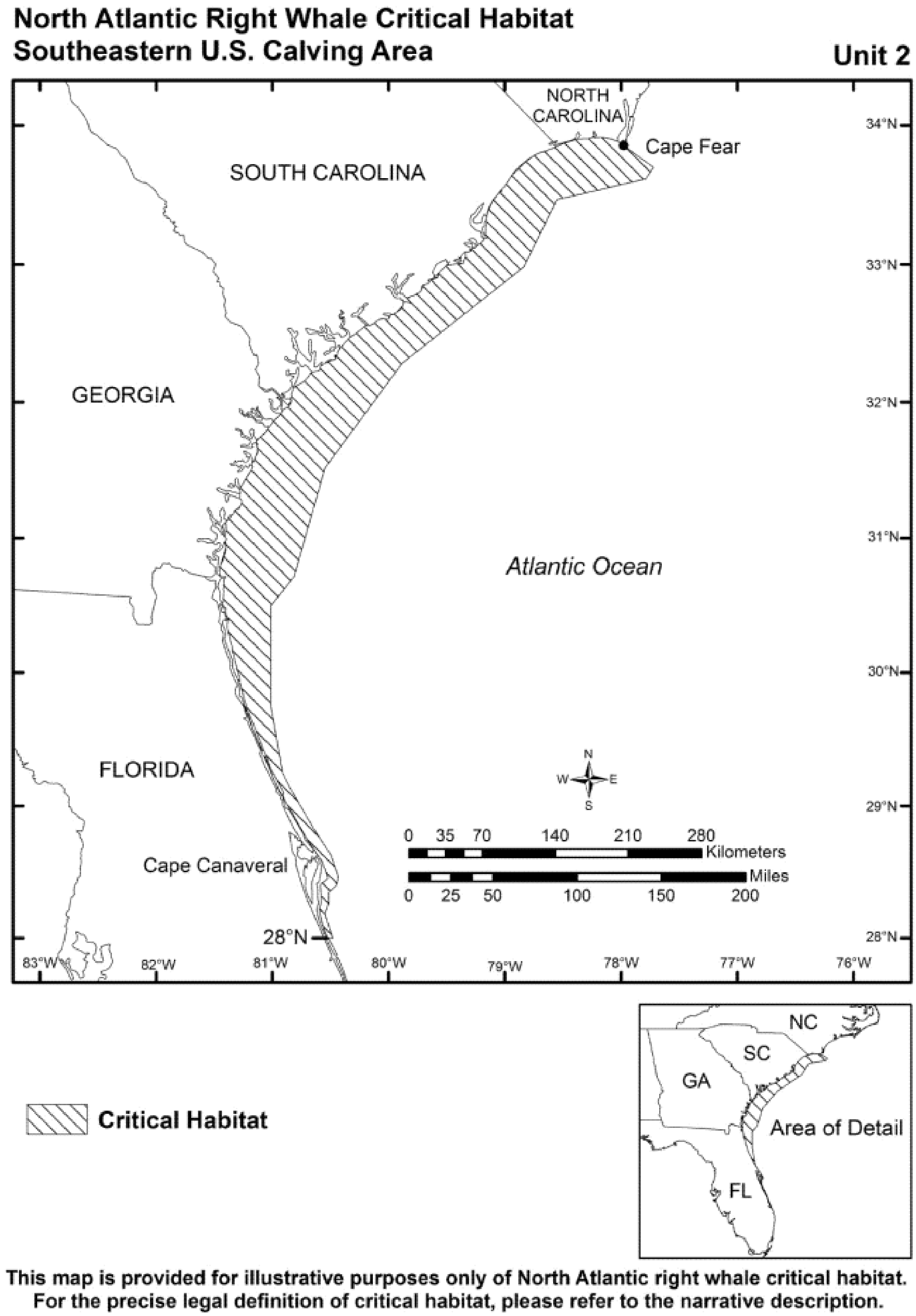


FIGURE 3-3. NORTH ATLANTIC RIGHT WHALE CRITICAL HABITAT UNIT 2: FORAGING CRITICAL HABITAT

3.2.2.2 Humpback Whale

The global listing status of the humpback whale as endangered was revised on September 8, 2016, when NMFS issued a final rule that revised the listing status of this species. NMFS divided the species into 14 distinct DPSs and reconsidered the global listing. In its place NMFS listed four DPSs as endangered and one DPS as threatened. The remaining nine DPSs including the West Indies DPS of which the GOM stock of humpback whale is included was delisted (81 FR 62259). MMPA stocks do not necessarily equate to DPSs under the ESA. While NMFS is evaluating the stock structure of humpback whales under the MMPA, no changes to current stock structure are proposed at this time. Therefore, while humpback whales in the NE LME are no longer classified under the ESA, the GOM stock remains protected under the MMPA. The GOM minimum population estimates is 1,393 whales (CV=0.15) (SAR 2020). PBR for the GOM stock of humpback whales is 22 whales (Hayes *et al.* 2020, SAR 2020).

3.2.2.3 Fin Whale

The most recent best abundance estimate available for the western North Atlantic fin whale stock is 6,802 (CV=0.24) (SAR 2020). This estimate was determined by adding the results of the 2016 NOAA shipboard and aerial surveys and the 2016 NEFSC and Department of Fisheries and Oceans, Canada (DFO) surveys (Central Virginia to Newfoundland). Because the survey areas did not overlap the estimates were added together and the CVs were pooled (SAR 2020). N_{min} is 5,573 and PBR for the western North Atlantic stock of fin whales is 11 (SAR 2020).

3.2.2.4 Minke Whale

The abundance estimate for the Canadian East Coast stock of minke whales in the Canadian East Coast stock is the sum of the 2016 NEFSC and DFO surveys is 24,202 (CV=0.30) (Hayes *et al.* 2020, SAR 2020). As with fin whales, the 2016 estimate is larger than those from 2011 because the 2016 estimate is derived from a survey area extending from Newfoundland to Florida, which is much larger than the 2011 survey area. In addition, the 2016 survey estimates in U.S. waters were corrected for availability bias (due to diving behavior), whereas the 2011 estimates were not. The minimum population size is 17,022 and PBR for this stock of minke whales is 170 (SAR 2020).

3.2.2.5 Sperm Whale

Sperm whales occur on the continental shelf edge, over the continental slope, and into mid-ocean regions (Hayes *et al.* 2020, SAR 2020). Sightings have been almost exclusively in the continental shelf edge and continental slope areas, but there currently is no reliable estimate of total sperm whale abundance for the entire North Atlantic because there has been little or no survey effort beyond the slope. The best recent abundance estimate for sperm whales is the sum of the 2016 surveys—4,349 (CV=0.28) and PBR for the western North Atlantic sperm whale is 6.9 (Hayes *et al.* 2020, SAR 2020).

3.2.2.6 Northern Bottlenose Whale

Northern bottlenose whales are extremely rare in U.S. waters. They are largely a deep water species and are seldom found in waters less than 2000 m deep (Mead 1989, Whitehead and Hooker 2012, as cited in

Waring *et al.* (2015). The current population off of the U.S. east coast is unknown and the PBR for this species is also unknown because the minimum population size cannot be determined (SAR 2020).

3.2.2.7 Curvier's Beaked Whale

The distribution of Cuvier's beaked whales is not well understood; it is based mostly on stranding records (Leatherwood *et al*. 1976 as cited in (Hayes *et al.* 2019)). Sightings of Cuvier's beaked whales have occurred primarily along the Mid-Atlantic continental shelf edge (CETAP 1982, Waring *et al.* 2001, Hamazaki 2002). They have been observed during every month of the year (Hayes *et al.* 2019). The best abundance estimate derived from shipboard and aerial surveys for undifferentiated beaked whales is 5,744 (CV=0.36), and the PBR for Curvier's beaked whales is 43 (Hayes *et al.* 2019, SAR 2020).

3.2.2.8 Risso's Dolphin

Risso's dolphins found worldwide in tropical and temperate seas; off the northeastern U.S. coast, they are distributed along the continental shelf edge from Cape Hatteras to Georges Bank during spring, summer, and fall (CETAP 1982, Payne *et al.* 1984. In winter, their range extends from the mid-Atlantic Bight outward into oceanic waters {Payne, 1984 #2353). The best abundance estimate for the Western North Atlantic stock is the sum of the estimates from the 2016 NEFSC and DFO surveys—35,493 (CV=0.19). The 2016 estimate is derived from a survey area that extends from Newfoundland to Florida, and some of the 2016 survey estimates in US waters were corrected diving behavior. PBR for the western North Atlantic stock of Risso's dolphin is 303 (Hayes *et al.* 2020, SAR 2020).

3.2.2.9 Long-finned and Short-finned Pilot Whales

Two species of pilot whale occur in the western Atlantic, long-finned and short-finned pilot whales; key uncertainties in the population size estimate are due to the uncertain separation between these species. Survey data have been combined with an analysis of the spatial distribution of the two species based on genetic analyses of biopsy samples to derive separate abundance estimates (Garrison and Rosel 2017 as cited in (Hayes *et al.* 2020). The best available estimate for long-finned pilot whales in the western North Atlantic is 39,215 (CV=0.30) and it's 28, 924 (CV=0.24 for short-finned pilot whales (Hayes *et al.* 2020, SAR 2020). The 2016 is derived from a survey area extending from Newfoundland to Florida, and the survey estimates in U.S. waters were corrected for availability bias (due to diving behavior. PBR for the western North Atlantic long-finned pilot whale is 306 and is 26 for short-finned pilot whales(Hayes *et al.* 2020, SAR 2020).

3.2.2.10 Atlantic White-sided Dolphin

White-sided dolphins are found in temperate and sub-polar waters of the North Atlantic, primarily in continental shelf waters to the 100-m depth contour (Hayes *et al.* 2020). The Gulf of Maine population of white-sided dolphins is most common in continental shelf waters from Hudson Canyon (approximately 39˚N) to Georges Bank, and in the Gulf of Maine and lower Bay of Fundy. The best available current abundance estimate for white-sided dolphins in the western North Atlantic stock is 93,233 (CV= 0.71). This estimate is derived from June–September 2016 surveys conducted by the U.S. and Canada that ranged from Labrador to the U.S. east coast (Hayes *et al.* 2020). PBR for the western North Atlantic stock is 544 (Hayes *et al.* 2020, SAR 2020).

3.2.2.11 White-beaked Dolphin

White-beaked dolphins are found in waters from southern New England to southern Greenland and Davis Straits; in waters off the northeastern U.S. coast, they are concentrated in the western Gulf of Maine and around Cape Cod (CETAP 1982). The best abundance estimate for the entire population of western North Atlantic white-beaked dolphins is 536,016 (CV=0.31); an abundance estimate for the Bay of Fundy/Scotian shelf is 5,478 (CV=0.5)(Hayes *et al.* 2020). Therefore, the majority of the population (abundance estimate 530,238) is found to the North of the NEFSC research area in waters of Newfoundland and Labrador (Hayes *et al.* 2020). PBR for the entire population is 4,153 (Hayes *et al.* 2020, SAR 2020).

3.2.2.12 Short-beaked Common Dolphin

The current best abundance estimate for Western North Atlantic stock of common dolphins is 172,974 (CV=0.21). This is based on data combined from Canadian and U.S. shipboard and aerial surveys conducted in 2016 and covers most of this stock's known range. The more recent estimate is larger than previous estimates because the 2016 estimate is derived from a larger survey area extending from Newfoundland to Florida. In addition, the earlier estimates were not corrected for availability bias (due to diving behavior). N_{min} is 145,216 and the PBR for the western North Atlantic stock of common dolphin is 1,452 (Hayes *et al.* 2020, SAR 2020).

3.2.2.13 Atlantic Spotted Dolphin

Atlantic spotted dolphins regularly occur in continental shelf and continental slope waters (Payne *et al.* 1984). The species can take two forms or ecotypes: a large, heavily spotted form that inhabits the continental shelf and is usually found inside or near the 200 m isobath in continental shelf waters south of Cape Hatteras; and a smaller, less spotted form which occurs in in continental slope waters particularly north of Cape Hatteras (Mullin and Fulling 2003 as cited in (Hayes *et al.* 2020)). The best abundance estimate available for these dolphins in the western North Atlantic is 39,921 (CV=0.27) (Hayes *et al.* 2020, SAR 2020). This estimate is species-specific and combines both the coastal and offshore forms. PBR for the combined offshore and coastal ecotypes of Atlantic spotted dolphins is 320 (Hayes *et al.* 2020, SAR 2020).

3.2.2.14 Striped Dolphin

Striped dolphins occur in the western North Atlantic from Nova Scotia to Jamaica; they seem to prefer continental slope waters offshore to the Gulf Stream (Leatherwood et al. 1976; Perrin et al. 1994; Schmidly 1981, as cited in (Hayes *et al.* 2020)). The best estimate of abundance for striped dolphins is 67,036 (CV=0.29), obtained from the 2016 surveys; PBR for the species is 529 (Hayes *et al.* 2020, SAR 2020).

3.2.2.15 Bottlenose Dolphin –Northern Coastal Migratory Stock

The best available abundance estimate for the Northern Migratory Coastal Stock of bottlenose dolphins in the western North Atlantic is 6,639 (Hayes *et al.* 2019, SAR 2020), as derived from summer 2017 aerial surveys of coastal and shelf waters from Assateague, Virginia, to Sandy Hook, New Jersey. The

minimum population estimate is 4,759 (Hayes *et al.* 2019, SAR 2020). Two large unusual mortality events (UMEs), one occurring 1987–1988 and another 2013–2015 (Morris *et al*. 2015 as cited in (Hayes *et al.* 2018)were attributed to morbillivirus epidemics (Lipscomb *et al*. 1994; Morris *et al*. 2015 as cited in (Hayes *et al.* 2018). Both UMEs included deaths of dolphins north of Assateague, Virginia in summer, which corresponds solely to the Northern Migratory Coastal Stock. Since only a single coastal stock of common bottlenose dolphin was thought to exist at that time, impacts to the Northern Migratory Coastal Stock alone are not known. Approximately 10 - 50% of the coast-wide stock is estimated to have died as a result of this UME (Scott *et al*. 1988 as cited in (Hayes *et al.* 2018). A total of 1,872 stranded common bottlenose dolphins were recovered in the UME area in 2013–2015 (Hayes *et al.* 2018). While some of these deaths may be from the Offshore Stock, the majority likely came from the Northern Migratory Coastal Stock given their geographic location. The impacts of two large UMEs on the status of this stock are unknown but an analysis of trends in abundance suggests a probable decline in stock size between 2010– 2011 and 2016. PBR for this stock is estimated at 48 dolphins (Hayes *et al.* 2018, SAR 2020).

3.2.2.16 Bottlenose Dolphin – Southern Coastal Migratory Stock

The best available abundance estimate for the Southern Migratory Coastal Stock of common bottlenose dolphins in the western North Atlantic is 3,751 (Hayes *et al.* 2019), as derived from summer 2016 aerial surveys of coastal and shelf waters from Florida to New Jersey. While historically occasional mortalities of common bottlenose dolphins during research activities have occurred (Waring *et al.* 2016), none were documented during 2011–2015 that could be ascribed to the Southern Migratory Coastal Stock (Hayes *et al.* 2018). As described for the Northern Migratory stock, two UMEs occurred (1987-1988 and 2013-2015) during a period when only a single stock had been identified. Therefore, the impacts of those UMEs on the Southern Stock are not fully understood (Hayes *et al.* 2018). PBR for this stock of common bottlenose dolphins is 23(Hayes *et al.* 2018, SAR 2020).

3.2.2.17 Harbor Porpoise

From July to September, harbor porpoises are concentrated in the northern GOM, southern Bay of Fundy and around the southern tip of Nova Scotia, generally in waters less than 150 m deep (Gaskin 1977; Kraus et al. 1983; Palka 1995 as cited in (Hayes *et al.* 2020)), with lower densities in the upper Bay of Fundy and on Georges Bank (Palka 2000, as cited in (Hayes *et al.* 2020)).The best current abundance estimate of the Gulf of Maine/Bay of Fundy harbor porpoise stock is 95,543 (CV=0.31), derived from the sum of the 2016 NEFSC and DFO surveys. PBR for the Gulf of Maine/Bay of Fundy harbor porpoise is 851(Hayes *et al.* 2020, SAR 2020).

3.2.2.18 Harbor Seal

Harbor seals inhabit the coastal waters of eastern Canada and Maine year-round (Katona et al. 1993, as cited in (Hayes *et al.* 2020)). They occur seasonally along the coast of southern New England to Virginia from September through late May (Schneider and Payne 1983; Schroeder 2000; Rees et al. 2016, Toth et al. 2018, all as cited in (Hayes *et al.* 2020)). The best current abundance estimate of harbor seals is 75,834 (CV=0.15) which is from a 2012 survey (Waring *et al.* 2015). PBR for the western North Atlantic stock of harbor seals is 2,006 (Hayes *et al.* 2020, SAR 2020).

3.2.2.19 Gray Seal

While current estimates of the total western Atlantic gray seal population are not available, estimates of portions of the stock are available for select time periods. Based on data collected in 2016, total pup production at breeding colonies in Canada and the U.S. was estimated to be 109,000 pups (den Heyer *et al.* 2020). The majority of these pubs are born in colonies located on Canadian waters. The total Canadian population was estimated to be 424,300 seals however, uncertainties in this number are derived from unknown mortality rates and sex ratios (DFO 2017 as cited in (Hayes *et al.* 2020). A minimum of 6,308 of pups born in 2016 at U.S. breeding colonies accounted for approximately 6% of the total pup production over the entire range of the stock. Considering pup counts are single day counts that have not been adjusted to account for pups born after the survey, or that left the colony prior to the survey, this percentage is considered a minimum estimate. den Heyer *et al.* (2020) provides an adjusted pup count of 6,500 for U.S. colonies. Regardless, the number of pups born at U.S. breeding colonies can be used to approximate the total size (pups and adults) of the gray seal population in U.S. waters, based on the ratio of total best population size to pups in Canadian waters (4.3:1). Based on this approach, the population estimate in U.S. waters is 27,131 animals (CV= 0.19) (Hayes *et al.* 2020, SAR 2020), a number which was previously reported in the 2016 PEA as unknown. PBR for the western North Atlantic stock of gray seals in U.S. waters is 1,389 animals (Hayes *et al.* 2020, SAR 2020). However, the same sources of uncertainty in calculating a minimum abundance estimate in U.S. waters as described here also apply to the estimate for PBR (Hayes *et al.* 2020).

3.2.3 Seabirds

3.2.3.1 Threatened and Endangered Seabird Species

Two bird species in the NEFSC research area are listed as endangered under the ESA, the Roseate tern (*Sterna dougallii*) and the Bermuda petrel (*Pterodroma cahow*). Table 3-8 presents an overview of the status and management actions taken since the 2016 PEA (NMFS 2016b) to conserve these species. Seabird species are discussed in Section 3.2.3.1 of the 2016 PEA. Since 2016, there were no takes of these species during NEFSC research and no ESA-listed species are likely to be encountered by future NEFSC research activities planned for 2021-2026. In 2018, USFWS initiated 5-year status reviews for Northeastern and Southeastern bird species, including the Roseate tern and Bermuda petrel. Results of these reviews are forthcoming. Considering that the populations of these seabird species have not significantly changed and that potential impacts from future fisheries and ecosystem research (see Chapter 2) is not expected to result in different conclusions from those presented in the original 2016 PEA impact assessment, ESA-listed seabird species are not discussed further in this SPEA.

TABLE 3-8. ESA-LISTED BIRDS OCCURRING IN NEFSC RESEARCH AREAS

ESA-Listed Seabird	2015 PEA Section Reference	SPEA Evaluation Required? (Yes/No)	Description	References
Roseate tern	3.2.3.1	No	No change in status. In 2018, USFWS initiated a 5-year status review of 19 Northeastern species, including the roseate tern.	83 FR 39113
Bermuda petrel	3.2.3.1	No	No change in status. In 2018, USFWS initiated a 5-year status review of 35 Southeastern species, including the Bermuda petrel.	83 FR 20092

3.2.3.2 Other Seabird Species

As described in Section 3.2.3.2 of the 2016 PEA (NMFS 2016b), seabird species protected under the MBTA (16 USC 703 et. seq.) are frequently found in NEFSC research areas (see Table 3.2-7 in the 2016 PEA). While some seabirds may interact with commercial fisheries also occurring in the area, seabirds have never been taken incidental to NEFSC research. There have been no changes in the status or overall population assessment of seabirds in NEFSC research areas since the 2016 PEA. Therefore, the analyses of fisheries and ecosystem research-related impacts on seabirds is not expected to differ from the original impact assessment, thus seabirds are not discussed further in this SPEA.

3.2.4 Sea Turtles

Five species of sea turtles can be found within the area of the proposed NEFSC research activities: leatherback, Kemp’s ridley, green, loggerhead, and hawksbill sea turtles (Table 3-9). As described in Section 3.2.4 of the 2016 PEA (NMFS 2016b), all of the sea turtles found in the area of the NEFSC research activities are listed as endangered. There has been, and continues to be, considerable research on sea turtles in the NE LME. For purposes of the SPEA, only published information since the 2016 PEA has been included in the following sections. On December 10, 2018, NMFS published the Annual Determination pursuant to the ESA identifying observer requirements for U.S. fisheries operating in the Atlantic, Gulf of Mexico and Pacific Ocean (83 FR 63483). Observer requirements for fisheries occurring in the NE LME are listed in Table 1 of 83 FR 63483. On December 16, 2016, Turtle Excluder Device (TED) requirements for shrimp-trawl fisheries were published in 81 FR 91097 and effective as of February 14, 2017. Other management actions have been taken since development of the 2016 PEA (NMFS 2016b) that impact sea turtles in the NE LME are described in Table 3-9. NEFSC is authorized to capture: loggerhead sea turtles, kemp’s ridley sea turtles, green sea turtles; and leatherback sea turtles. Therefore, the potential impacts of the alternative on this species are discussed in Chapter 4. Interactions with the hawksbill sea turtle are not expected and the analysis in the 2016 PEA remains valid.

3.2.4.1 Leatherback Sea Turtle

Leatherback turtles are currently listed as endangered throughout its range under the ESA (35 FR 8491, June 2, 1970). On September 20, 2017, NMFS received a petition from Blue Water Fishermen's Association to identify the Northwest Atlantic leatherback turtle as a DPS and list it as threatened under the ESA (82 FR 57565). NMFS found that the petitioned action may be warranted and initiated an ESA status review to determine if a changing in listing status was warranted. Climate change and fisheries bycatch are two anthropogenic threats listed in the petition as having the largest population-level effects on the Northwest Atlantic leatherback turtle. During the status review, NMFS and USFWS will consider the species in light of the DPS Policy and evaluate the extinction risk of any such DPS. See Chapter 4 for assessment of potential impacts to Loggerhead turtles under future proposed NEFSC research.

3.2.4.2 Green Sea Turtle

A comprehensive status review of the species was conducted and published as the ‘‘Status Review of the Green Turtle (*Chelonia mydas*) under the Endangered Species Act’’ (Seminoff *et al.* 2015). Based on the best scientific information presented in the status review (80 FR 15271), a final rule was published on April 6, 2016 which removed the existing ESA listings, changing them to three endangered DPSs and eight threatened DPSs (including the North Atlantic DPS). Most green turtle nesting in the continental U.S. occurs on the Atlantic Coast of Florida (Erhart 1979). As with loggerhead and Kemp's ridley sea turtles, green sea turtles also use Mid-Atlantic and northern areas of the western Atlantic coast as important summer developmental habitat. Green turtles are found in estuarine and coastal waters as far north as Long Island Sound, Chesapeake Bay, and North Carolina sounds (Musick and Limpus 1997). Despite the change in ESA status, the level of interaction with proposed fisheries research does not warrant further evaluation under SPEA alternatives.

TABLE 3-9. ESA-LISTED SEA TURTLES FOUND WITHIN THE NEFSC RESEARCH AREA

ESA-Listed Turtle Species	2015 PEA Section Reference	SPEA Evaluation Required? (Yes/No)	References	Description
Leatherback sea turtle (E)	3.2.4	Yes	82 FR 57565	No change in endangered status. December 6, 2017, NMFS published a 90-day finding that identifying the Northwest Atlantic subpopulation of the leatherback turtle as a DPS and threatened under the ESA may be warranted. This review is ongoing.
Kemp's ridley (E)	3.2.4	Yes	NMFS and USFWS (2007)	No change in status. Nonlethal takes have occurred.
Green sea turtle (T) *North Atlantic DPS*	3.2.4	Yes	81 FR 20057	Change in status listing status from endangered to threatened based on status review March 2015 and final ruling April 6, 2016. Non-lethal takes have occurred.

ESA-Listed Turtle Species	2015 PEA Section Reference	SPEA Evaluation Required? (Yes/No)	References	Description
Loggerhead sea turtle (T) *NW Atlantic Ocean DPS*	3.2.4	Yes	NMFS and USFWS (2008)	No change in status. Nonlethal takes have occurred.
Hawksbill sea turtle (E)	3.2.4	No	NMFS and USFWS (2013a)	No change in status. Interactions with NEFSC research not expected. Further evaluation under SPEA alternatives not warranted

[1]Threatened except for the Florida breeding population which is listed as endangered.

3.2.5 Invertebrates

There is great variation in the abundance and distribution of invertebrate populations between and within the LME subareas, with concentrations of different species reflecting differences in sediment composition, depth, water temperature, food availability and other factors (NEFSC 2011a, as cited in (NMFS 2016b). A brief overview of benthic communities and general biomass is provided in Section 3.2.5 of the 2016 PEA. Publicly available data available since 2016 have been reviewed to identify notable changes in status, abundance, or population trends that may require further discussion in this SPEA. Based on the review, the best available information indicates that there have been no changes in species status since the 2016 PEA (NMFS 2016b), and fisheries research-related impacts from Alternatives 1 and 2 are not expected to be different from the original impact assessment. Therefore, these species are not discussed further in this SPEA. Individual status and assessment reports for each species are shown in Table 3-10.

TABLE 3-10. TARGET INVERTEBRATE SPECIES FOUND WITHIN THE NEFSC RESEARCH AREA

Invertebrate Species	2015 PEA Section Reference	SPEA Evaluation Required? (Yes/No)	Description	References
American lobster	3.2.5.2	Yes	ASFMC completed a status review of American lobster in 2018. The GOM/GBK stock is not overfished and not experiencing overfishing. However, the SNE stock is severely depleted and in need of protection. The next stock assessment is scheduled for 2020.	ASMFC (2018b)
Northern shrimp	3.2.5.2	Yes	Northern shrimp remains depleted. Biomass has been extremely low since 2011. Spawning stock biomass in 2017 was estimated at 709 mt, well below the time series mean of 3,473 mt. November 2018, moratorium on commercial fishing extended through 2021.	ASMFC (2019c)
Longfin squid	3.2.5.2	No	No change in status. The U.S. Northeast longfin squid fishery was certified as sustainable in May 2018. Additional evaluation under SPEA alternatives not warranted.	DeAlteris *et al.* (2018) Macho and Humberstone (2019)
Northern shortfin squid	3.2.5.2	No	No change in status. Though Northern shortfin squid U.S. stock is listed as not subject to overfishing the 2006 stock assessment was not able to precisely determine current exploitation rates or stock biomass. Nevertheless, the overfishing status of this stock remains unchanged and un-revisited (NMFS 2017 as cited in Macho and Humberstone 2019). Additional evaluation under SPEA alternatives not warranted.	Macho and Humberstone (2019)
Atlantic surfclam	3.2.5.2	No	No change in status. April 2018, final rule for Framework 2 - Omnibus Acceptable Biological Catch (ABC) Framework established a process for setting constant multi-year ABC limits for Council-managed fisheries (including these species) and clarified the process for setting ABCs. Effective 5/11/2018. Additional evaluation under SPEA alternatives not warranted.	MAFMC (2019)
Atlantic sea scallop	3.2.5.2	No	No change in status. Additional evaluation under SPEA alternatives not warranted.	NEFSC (2018b) Anhalzer *et al.* (2018)

Invertebrate Species	2015 PEA Section Reference	SPEA Evaluation Required? (Yes/No)	Description	References
Horseshoe crab	3.2.5.2	Yes	To date, no overfishing or overfished definitions have been adopted. A 2019 Horseshoe Crab Benchmark Stock Assessment evaluated stock status by region; populations within Delaware Bay and Southeast regions remain "neutral" and "good", respectively. The Northeast region population has changed from "poor" to "neutral", while status New York region population has trended downward from to "poor"[1].	ASMFC (2019b)
Deep sea red crab	3.2.5.2	No	No change in status. In December 2018, NMFS published a final rule to establish allowable 2019 harvest levels, consistent with the Atlantic Deep-Sea Red Crab Fishery Management Plan.	83 FR 66161

3.2.5.1 Threatened and Endangered Species

No invertebrate species in the NEFSC research area are ESA-listed. Therefore, these species are not discussed further in this SPEA.

3.2.5.2 Target Species of Invertebrates

Nine species of invertebrates were described in Section 3.2.5.2 of the 2016 PEA and are the only invertebrate species within the NEFSC research areas that are considered target invertebrate species. The status of these species since 2016 is reported below in Table 3-10. Some species are not expected to differ from those discussed in Chapter 4 of the 2016 PEA. Therefore, these species are not discussed further in this SPEA.

3.2.5.2.1 American Lobster

A status review of the American lobster was completed by ASFMC in 2018 (ASMFC 2018b) . The GOM/GBK stock is not overfished and not experiencing overfishing. However, the SNE stock is severely depleted and in need of protection. The SNE stock is in recruitment failure and has continued to decline. American lobster is managed under Amendment 3 to the Interstate FMP for American Lobster. Addendum XVIII of Amendment 3 established a series of trap reductions in lobster conservation management areas (LCMAs) 2 and 3[3], with the intent of scaling the size of the SNE fishery to the size of the resource. The next stock assessment is scheduled for 2020 (ASMFC 2018b).

[3]These areas include the: Inshore Southern New England (Area 2) and Offshore Waters (Area 3).

3.2.5.2.2 Northern Shrimp

Northern shrimp remains depleted. Biomass has been extremely low since 2011. Spawning stock biomass in 2017 was estimated at 709 mt, well below the time series mean of 3,473 mt. The stock assessment estimated recruitment in 2017 at 2.05 billion shrimp, well below median recruitment of 4.38 billion shrimp. In response to low biomass, in November 2018, a moratorium on commercial fishing was extended through 2021 (ASMFC 2019c). In the absence of biological reference points, stock status was based on the percentage of surveys within a region (or coastwide) having a >50% probability of the final year being below the model reference point. "Poor" status was >66% of surveys meeting this criterion, "Good" status was <33% of surveys, and "Neutral" status was 34–65% of surveys (ASMFC 2019c).

3.2.5.3 Other Species

Other invertebrate species that have been encountered during NEFSC research are listed in Table 3.2-10 of the 2016 PEA. These species are not managed by any federal or state agencies within the NE LME. While commercial fisheries have listed the following two invertebrates as significant bycatch, less than 2,200 pounds have been encountered in the NEFSC research surveys.

- Cancer crab (including Atlantic rock crab (*Cancer irroratus*) and Jonah crab (*Cancer borealis*)
- Icelandic scallop (*Chlamys islandica*)

The status of these species has not changed since the 2016 PEA (NMFS 2016b). However, cancer crabs are now managed by the ASFMC which began in 2016 (ASMFC 2015). Considering species status remains the same and that NEFSC research results in a low level of bycatch, these species are not further evaluated in this SPEA.

3.2.6 Vegetation

Johnson's seagrass (*Halophilia johnsonii*) was listed as threatened in 1998 (63 FR 49035) and critical habitat was designated in 2000 (65 FR 17786). Johnson's seagrass is rare and limited in its range which primarily includes the east coast of Florida from Sebastien Inlet to central Biscayne Bay. Due to its shallow root system, this species is sensitive to destruction from activities that may disturb the seafloor including but not limited to dredging, scarring from anchors or propellers, siltation from runoff and natural disturbances such as storms.

In April of 2000, ten areas off of the Florida coast were designated as critical habitat for Johnson's seagrass (65 FR 177786). COASTSPAN surveys occasionally set longline gear in these areas from small boats.

3.3 Economic and Social Environment

3.3.1 NEFSC Operations

The NEFSC fisheries and ecosystem research activities have direct and indirect influence on the economics of U.S. communities and ports in which they operate. As described in the 2016 PEA, research-related spending directly generates jobs and income, and benefits businesses in the private economy by expenditures on research-related equipment. The NEFSC carries out research in facilities located in Massachusetts, Rhode Island, Connecticut, New Jersey, Washington DC, and Maine. At sea assessments extend south across the Atlantic Seaboard. Therefore, communities that may be affected by proposed NEFSC research are located within these coastal states. The NEFSC's annual spending fluctuates but has averaged about $60 million in the 2008-2012 period (NEFSC Operations Management and Information Staff pers. comm. 2013). The annual spending from the period of 2013–2019 average was $69.6 million.

Through direct expenditures on fisheries and ecosystem research, NEFSC contributes to the communities and ports in these regions. While the contribution of research-related employment and purchased services is beneficial on an individual basis, the total contribution of research is very small when compared to the value of commercial and recreational fisheries in the communities. Fisheries research is considered beneficial to the economic status of fishing communities through contribution to sustainable fisheries management.

The NEFSC routinely charters University-National Oceanographic Laboratory System (UNOLS) research vessels and commercial fishing vessels to conduct various types of fisheries research and cooperative research. From 2008 through 2010, the number of leased vessel days has ranged from 69 (2008) – 150 (2010) operating days with a total budget ranging from $595,000 (2008) to $1,400,000 (2010). From 2011 - 2019, the number of leased vessel days has ranged from 100 - 180 operating with a total budget ranging from $1m - $1.8m. Cooperative Research grants and Research Set Aside programs also generate a certain amount of vessel leasing activities by external grant recipients. Fees generated from leasing contribute to the local economies and may be an important component of total income for some vessel owners.

In addition to leasing vessels, fisheries research contributes to local economies through operational support of NOAA vessels and chartered vessels (fuel, supplies, crew wages, shoreside services), operational costs of research support facilities (utilities, supplies, services), and employment of researchers who live in nearby communities. The NEFSC spent approximately $15.7 million annually in support of the fisheries research activities covered in this SPEA, including charter fees and operating costs for all vessels, salaries for federal and contractual staff participating in fisheries research, travel, and other incidental expenses, but not including capital costs of vessels and facilities prior to 2011 (NEFSC Operations Management and Information Staff pers. comm. 2013). During the period of 2011 to the present, NEFSC has spent approximately $17 million annually in support of the fisheries research activities covered in this SPEA, including charter fees and operating costs for all vessels, salaries for federal and contractual staff participating in fisheries research, travel, and other incidental expenses, but not including capital costs of vessels and facilities prior to 2011 (NEFSC Operations Management and Information Staff pers. comm. 2019).

To assess the potential influence of NEFSC research on the communities described above, the 2016 PEA and this SPEA rely on information from the commercial and recreational fisheries to provide a general sense of revenues and economic impact. Every year, NMFS publishes a report titled ‘The Fisheries Economics of the United States’. This report includes commercial market conditions, total tonnage of commercial fish landed and revenue by region and state, recreational fishing expenditures and levels of participation by region and state, key species, and community profiles. The 2018 report covers the period 2007-2016 (NMFS 2018a). To assess socio-economic impacts in this SPEA, information from 2015-2016 (NMFS 2018a) is compared to data for the period 2012 reported in the 2016 PEA[4]. For more detailed information on the entire time-series presented in the annual report, please refer to NMFS (2018a).

NMFS (2018a)identifies four different measures commonly used to show how commercial fisheries landings/revenue affect the economy in a region (state or nationwide) which include: sales, income, value-added, and employment. Economic impact modeling assumes that every dollar spent in a regional economy (direct impact) is either saved or re-spent on additional goods or services. Dollars that are re-spent on other goods and services in the regional economy generate additional economic activity in the region (NMFS 2018a).

For both commercial and recreational fisheries, sales include: direct sales of landed fish or sales by an angler; and secondary sales made between businesses and households resulting from the original sale. Income includes: wages, salaries, and proprietors’ income (income from self-employment). Value-added is the contribution of commercial and recreational fisheries to the gross domestic product in a region. Employment is specified on the basis of full-time and part-time jobs supported directly or indirectly by the sales of seafood, purchases by recreational angle, or items purchased to support commercial and recreational fishing (NMFS 2018a).

3.3.2 Commercial Fisheries

Table 3-11 summarizes the economic significance of commercial fishing to each state for the year 2017[5]. Commercial fisheries refer to fishing operations that sell their catch for profit. The term does not include subsistence fishermen or saltwater anglers who fish for sport. It also excludes the for-hire sector, which earns its revenue from selling recreational fishing trips to saltwater anglers and imports from other locations. As shown in Table 3-11, Massachusetts generated the largest employment impacts in the New England region while Virginia had the highest number of jobs for Mid-Atlantic states.

As shown in Table 3-12, landings revenue in New England was up $85.4 million in 2016 from the previous year, with lobster (up $46 million), sea scallops (up $17.1 million) and squid (up $17.4 million) accounting for the majority of this increase (NMFS 2018a). The lobster fishery was up 84% ($46 million) since 2007 and was New England’s largest fishery in terms of revenue due to landings which have almost doubled (up 99%). Higher landings are attributed to record American lobster abundance in the GOM. While revenue for sea scallops was still high, landings have actually declined by 30% since 2007, partially due to a catch limit that was implemented in 2012 (NMFS 2018a). In the Mid-Atlantic, landings revenue was $550.s million in 2016, a 30% increase from 2007 (14% after adjusting for

[4]Note the draft and final PEA used fisheries datasets up to 2012, so information from 2010-2012 is representative of that described in the 2015 PEA.

[5] https://www.fisheries.noaa.gov/data-tools/fisheries-economics-united-states-interactive-tool#

inflation). Revenue from landings was highest in Virginia ($204.7 million). Shellfish landings accounted for the greatest revenue (80%), including sea scallops and blue crab (54% of total landings revenue). Eastern oyster, squid and surfclams had the greatest increases in landings revenue between 2007 and 2016. Sea scallop harvest was up in the region, accounting for 28% of total landings. As seen in Table 3-11, Massachusetts generated the highest number of jobs from commercial fishing (59,821 jobs) in 2017.

TABLE 3-11. 2017 ECONOMIC IMPACTS OF THE NEW ENGLAND REGION AND MID-ATLANTIC REGION SEAFOOD INDUSTRY[1]

State	Jobs (#)	Sales (thousands $)	Income (thousands of $)	Value Added (thousands of $)
Connecticut	721	$48,482	$16,617	$23,166
Maine	31,943	$1,857,960	$642,926	$918,865
Massachusetts	59,821	$2,546342	$937,737	$1,278,180
New Hampshire	2,665	$168,700	$62,428	$85,371
Rhode Island	5,539	$357,456	$130,592	$182,284
Delaware	345	$44,761	$9,480	$15,203
Maryland	6,239	$371,659	$136,798	$186,325
New Jersey	7,987	$728,249	$242,015	$347,466
New York	3,343	$175,702	$61,049	$85,393
Virginia	13,858	$870,486	$330,891	$448,721

Source: https://www.fisheries.noaa.gov/data-tools/fisheries-economics-united-states-interactive-tool#
[1]Without imports.

TABLE 3-12. COMMERCIAL LANDINGS, REVENUE, AND TOP 2 SPECIES (BY REVENUE) FOR NEW ENGLAND AND MID-ATLANTIC STATES 2012, 2015 AND 2016

All Species (Total)			Top Species Revenue				Top Species Percent of All Species	
Year	Pounds	Revenue ($ Thousands)	Pounds	Revenue	Price per Pound	Top 2 Species	Pounds	Revenue
Connecticut								
2012	8,940	21,132	248	1,057	4.26	Lobster	2.8%	5.0%
			1,231	12,005	11.29	Sea Scallops	13.8%	56.8%
2015	9,390	15,422	205	1,073	5.23	Lobster	2.2%	7.0%
			577	7,039	12.20	Sea Scallops	6.1%	45.6%
2016	12,370	15,087	259	1,316	5.09	Lobster	2.1%	8.7%
			530	5,881	11.09	Sea Scallops	4.3%	39.0%
Maine								
2012	263,421	341,861	127,237	341,861	2.69	Lobster	48.3%	75.8%
			92,506	14,490	0.16	Atlantic herring	35.1%	3.2%
2015	242,662	501,194	122,402	501,194	4.09	Lobster	50.4%	84.8%
			86,485	13,534	0.16	Atlantic herring	35.6%	2.3%
2016	247,946	537,872	131,954	537,872	4.08	Lobster	53.2%	85.0%
			78,156	19,422	0.25	Atlantic herring	31.5%	3.1%
Massachusetts								
2012	296,037	616,466	14,485	53,357	3.68	Lobster	4.9%	8.7%
			36,725	364,864	9.93	Sea Scallops	12.4%	59.2%
2015	260,347	524,112	16,451	78,290	4.76	Lobster	6.3%	14.9%
			21,515	264,933	12.31	Sea Scallops	8.3%	50.5%
2016	244,218	550,755	17,687	82,007	4.64	Lobster	7.2%	14.9%
			22,867	281,445	12.31	Sea Scallops	9.4%	51.1%

All Species (Total)			Top Species Revenue				Top Species Percent of All Species	
Year	**Pounds**	**Revenue ($ Thousands)**	**Pounds**	**Revenue**	**Price per Pound**	**Top 2 Species**	**Pounds**	**Revenue**
New Hampshire								
2012	12,148	23,241	4,229	17,169	4.06	Lobster	34.8%	73.9%
			726	1,705	2.41	Atlantic cod	6.0%	7.3%
2015	11,094	27,816	4,722	24,546	5.20	Lobster	42.6%	88.2%
			45	93	2.09	Atlantic cod	0.4%	0.3%
2016	7,926	33,215	5,782	30,372	5.25	Lobster	72.9%	91.4%
			55	109	1.97	Atlantic cod	0.7%	0.3%
Rhode Island								
2012	85,232	81,136	2,709	12,119	4.48	Lobster	3.2%	14.9%
			11,689	12,744	1.09	Squid	13.7%	15.7%
2015	75,633	81,833	2,316	12,345	5.33	Lobster	3.1%	15.1%
			20,495	20,288	0.99	Squid	27.1%	24.8%
2016	82,539	93,872	2,260	11,889	5.26	Lobster	2.7%	12.7%
			32,914	33,938	1.03	Squid	39.9%	36.2%
Delaware								
2012	5,640	8,464	4,571	4,576	1.46	Blue crab	81.0%	54.1%
			190	766	2.47	Striped bass	3.4%	9.1%
2015	3,529	6,846	2,124	4,498	2.12	Blue crab	60.2%	65.7%
			144	465	3.23	Striped bass	4.1%	6.8%
2016	4,980	10,097	3,928	7,856	2.00	Blue crab	78.9%	77.8%
			137	505	3.70	Striped bass	2.8%	5.0%

All Species (Total)			Top Species Revenue				Top Species Percent of All Species	
Year	**Pounds**	**Revenue ($ Thousands)**	**Pounds**	**Revenue**	**Price per Pound**	**Top 2 Species**	**Pounds**	**Revenue**
Maryland								
2012	75,416	85,069	43,737	60,467	1.38	Blue crab	58.0%	71.1%
			2,541	6,933	2.73	Striped bass	3.4%	8.1%
2015	54,248	88,839	28,674	52,026	1.81	Blue crab	52.9%	58.6%
			1,752	6,357	3.63	Striped bass	3.2%	7.2%
2016	56,316	94,814	34,861	60,677	3.30	Blue crab	61.9%	64.0%
			1,709	7,102	4.15	Striped bass	3.0%	7.5%
New Jersey								
2012	180,505	187,707	11,379	110,560	9.72	Sea scallops	6.3%	58.9%
			38,921	23,453	0.65	Ocean quahog & surfclams	21.6%	12.5%
2015	148,419	166,181	7,847	97,856	12.47	Sea scallops	5.3%	58.9%
			18,283	10,889	0.60	Ocean quahog & surfclams	12.3%	6.6%
2016	123,565	193,011	10,481	123,266	11.76	Sea scallops	8.5%	63.9%
			16,492	9,970	0.60	Ocean quahog & surfclams	13.3%	5.2%
New York								
2012	35,864	54,524	1,299	9,218	7.10	Ocean quahog	3.6%	16.9%
			7,838	8,648	1.10	Loligo squid	21.9%	15.9%
2015	27,002	51,372	1,898	12,244	6.45	Ocean quahog	7.0%	23.8%
			4,259	5,413	1.27	Loligo squid	15.8%	10.5%
2016	29,152	47,731	2,166	11,914	5.50	Ocean quahog	7.4%	25.0%
			6,275	7,795	1.24	Loligo squid	21.5%	16.3%

All Species (Total)			Top Species Revenue				Top Species Percent of All Species	
Year	**Pounds**	**Revenue ($ Thousands)**	**Pounds**	**Revenue**	**Price per Pound**	**Top 2 Species**	**Pounds**	**Revenue**
Virginia								
2012	462,503	174,534	5,798	54,076	9.33	Sea scallops	1.3%	31.0%
			33,144	24,561	0.74	Blue crab	7.2%	14.1%
2015	417,487	200,485	4,020	48,806	12.14	Sea scallops	1.0%	24.3%
			29,682	33,104	1.12	Blue crab	7.1%	16.5%
2016	383,523	204,690	4,529	51,315	11.33	Sea scallops	1.2%	25.1%
			28,135	40,862	1.45	Blue crab	7.3%	20.0%

Source: NMFS (2018a). https://www.fisheries.noaa.gov/national/sustainable-fisheries/fisheries-economics-united-states#previous-reports

3.3.3 Recreational Fisheries and Fishing

In 2016, 1.2 million recreational anglers who were residents in New England fished in that region, 26% less than in 2007. This equated to a total of 6.1 million trips, most (55%) of which were taken in private boats. Massachusetts had the highest recorded number of trips (2.4 million), with Connecticut having the second highest with 1.6 million (Table 3-13). Across New England, expenditures on equipment and trips totaled $1.9 billion in 2016, with the largest portion of expenditures on boat expenses ($1 billion). Employment impacts (full- and part-time jobs) from recreational fishing were greatest in Massachusetts (10,000), followed by Rhode Island (4,200) (NMFS 2018a).

In the Mid-Atlantic Region, there were 2.4 million residents from the region who fished recreationally, representing a 30% decrease from 2007. Fishermen and fisherwomen took 14 million fishing trips during 2016 which was a 37% decrease from 2007. The majority of recreational trips were on private boats (55%) (NMFS 2018a). New Jersey had the greatest expenditures (both in trips and durable equipment) for recreational fishing, with a total of $3.9 billion. New Jersey also created the highest number of jobs from recreational fishing (15,400), followed by New York (10,400) (NMFS 2018a).

TABLE 3-13. 2016 ECONOMIC IMPACTS OF THE NEW ENGLAND AND MID-ATLANTIC REGION RECREATIONAL FISHERIES (THOUSANDS OF DOLLARS, TRIPS)

State	Trips	No. of Jobs	Sales	Income	Value Added
Connecticut	1,644	3,974	430,216	186,430	291,827
Maine	573	1,097	98,666	37,412	59,185
Massachusetts	2,384	9,957	1,070,935	495,481	715,659
New Hampshire	293	473	47,954	21,470	30,575
Rhode Island	1,159	4,173	412,071	176,221	270,081
Delaware	910	1,658	168,169	67,446	110,381
Maryland	2,383	7,608	784,528	327,372	512,722
New Jersey	4,306	15,363	1,751,578	746,203	1,167,991
New York	4,294	10,404	1,127,261	488,015	770,189
Virginia	2,108	5,893	583,806	239,344	378,694

Source: NMFS (2018a)

3.3.4 Fishing Communities

NMFS has identified 17 major fishing ports in the New England and Mid-Atlantic regions that significantly engage in commercial or recreational fisheries. These communities have a long history of supporting the commercial and recreational fishing industries (NMFS 2018b), including Gloucester, Massachusetts, the oldest fishing port in the U.S. Table 3-14 lists statistics for each of these major ports in terms of millions of pounds of fish landed as well as revenue (in millions of dollars). The leading fishing port by revenue for 2016 and 2017 was New Bedford, Massachusetts with over $300 million in revenue for both years. Reedville, Virginia had the highest landings (in pounds) of these 17 ports, with over 300 million pounds landed in 2016 and 2017 (NMFS 2018a).

TABLE 3-14. FISHERY LANDINGS BY TOP 17 PORTS IN THE NEW ENGLAND AND MID-ATLANTIC REGIONS IN MILLIONS OF POUNDS AND MILLIONS OF DOLLARS FOR 2016 AND 2017

Port by State	Millions of Pounds 2016	Millions of Dollars	Millions of Pounds 2017	Millions of Dollars 2017
Atlantic City, New Jersey	24.3	$19.7	24.7	$18.6
Boston, Massachusetts	12.2	$17	15.8	$17.3
Cape May, New Jersey	46.6	$84.7	101.6	$81
Gloucester, Massachusetts	63.4	$52.4	63.9	$52.6
Hampton Roads, Virginia	12.3	$61	15.5	$58.1
New Bedford, Massachusetts	106.6	$326.5	110.8	$389.5
Newington, New Hampshire	3.9	21.7	4.1	24.8
North Kingstown, Rhode Island	17.6	$13.7	27	$17.7
Point Judith, Rhode Island	53.4	$55.7	44.3	$57.4
Point Pleasant, New Jersey	26.3	$32.1	37.5	$35.3
Portland, Maine	49.8	$38.1	49.2	$30.5
Portsmouth, New Hampshire	2	$7.1	4.6	$6.9
Provincetown-Chatham, Massachusetts	26.5	$32.8	22.3	$33.8
Reedville, Virginia	321.3	$31.2	319.9	$32.5
Rockland, Maine	33.6	$21.1	23.3	$15
Stonington, Maine	23.2	$68	17.9	$55.8
Vinalhaven, Maine	10.5	$42.3	8.8	$36.5

Source: NMFS (2018a)

4 ENVIRONMENTAL EFFECTS

Chapter 4 describes the potential environmental consequences of the Status Quo/No Action alternative (Alternative 1) and the proposed NEFSC fisheries and ecosystem research activities for the period 2021–2026 (Alternative 2) as described in Chapter 2. As a supplement to the original PEA published by NMFS in 2016 which analyzed a full suite of fisheries and ecosystem research, this SPEA focuses only on those new or modified research activities that were not previously evaluated in the 2016 PEA (NMFS 2016b). This SPEA also summarizes potential impacts of fisheries and ecosystems research due to recent (2016-2019) changes in resources within the research areas described in Chapter 1 (see Figure 1-1). As described in Chapter 3, if changes to physical, biological or socioeconomic resources do not alter the conclusions from the 2016 PEA, those resources are not discussed further in this SPEA. Resources described in Tables 3-1 through 3-14 were evaluated in terms of whether: 1) proposed future NEFSC research would result in a different conclusion presented in the 2016 PEA; and 2) whether any recent changes such as species status (i.e., ESA status or whether a target species is considered overfished), changes in environmental conditions, or socioeconomic conditions warrant additional evaluation under the proposed SPEA alternatives. Cumulative effects, including but not limited to the influence of climate changes on resources within the Action Area, are discussed in Chapter 5. For an evaluation of potential effects of research on all other resources please see the 2016 PEA (NMFS 2016b).

4.1 Methodology and Impact Criteria

Section 4.1 of the 2016 PEA describes the methodology used to evaluate potential direct, indirect and cumulative effects of fisheries and ecosystem research and consists of the following steps:

1. Review and understand the proposed action and alternatives (Chapter 2).
2. Identify and describe:
    a. Direct effects that would be "caused by the action and occur at the same time and place" (40 CFR § 1508.8(a)), and
    b. Indirect effects that would be "caused by the action and (would occur) later in time or farther removed in distance but are still reasonably foreseeable" (40 CFR § 1508.8(b)).
3. Compare the impacts to the baseline conditions described in Chapter 3 and rate them as major, moderate, or minor.

Consistent with the approach used in the 2016 PEA, the criteria shown in Table 4-1 are used to evaluate SPEA Alternatives 1 and 2 for those resources identified in Chapter 3 as requiring additional evaluation due to new information and/or the proposed scope of new research proposed for 2021–2026. The criteria provide guidance to place the impacts of the alternatives in an appropriate context, determine their level of intensity, and assess the likelihood that they would occur. Some evaluation criteria have also been based on legal or regulatory limits or requirements (see description of criteria for marine mammals Section 4.1.2 below), and best management practices. The evaluation criteria include both quantitative and qualitative thresholds as appropriate to each resource. Overall ratings of impacts (e.g., minor, moderate, adverse or beneficial, or no effect) are determined for a given resource by combining the assessment of the impact components.

Different types of impacts are determined for different resources as applicable. All biological resources are analyzed for impacts due to potential M/SI from surveys. Disturbance due to sound sources is analyzed for fish, marine mammals and turtles and prey removals are analyzed for marine mammals. Analyses are based on the best available data and as such, may vary in terms of the periods for which data are readily available. For example, potential effects of research on fish species are based on data through 2017 while marine mammal stock assessments through 2018 have been used for analyses of effects on marine mammals.

Certain categories of effects are not considered in this SPEA. For example, in the 2016 PEA, potential effects of contamination due to discharges from vessels, whether accidental or intentional, were evaluated. Discharges may include sewage, ballast water, fuel, oil, miscellaneous chemicals, garbage, and/or plastics. During NEFSC research activities from 2016–2019, there were no measurable discharges from any vessels. While discharges could still occur during future research (2021-2026), this type of event is expected to be rare. The potential effects of such discharge would be the same as described in the 2016 PEA (NMFS 2016b) and is therefore, not evaluated further in this SPEA.

In developing this SPEA, NMFS adhered to the procedural requirements of NEPA; the CEQ regulations for implementing NEPA (40 CFR 1500-1508), and NOAA's procedures for implementing NEPA[6].

[6]NOAA Administrative Order (NAO) 216-6, Environmental Review Procedures for Implementing the National Environmental Policy Act.

TABLE 4-1. CRITERIA FOR DETERMINING EFFECT LEVELS

Resource Components	Assessment Factor	Effect Level		
		Major	**Moderate**	**Minor**
Physical Environment	**Magnitude or intensity**	Large, acute, or obvious changes that are easily quantified	Small but measurable changes	No measurable changes
	Geographic extent	> 10% of project area (widespread)	5-10% of project area (limited)	0-5% of project area (localized)
	Frequency and duration	Chronic or constant and lasting up to several months or years (long-term)	Periodic or intermittent and lasting from several weeks to months (intermediate)	Occasional or rare and lasting less than a few weeks (short-term)
	Likelihood	Certain	Probable	Possible
Biological Environment	**Magnitude or intensity**	Measurably affects population trend For marine mammals, mortality and serious injury greater than or equal to 50% of PBR[1]	Population level effects may be measurable For marine mammals, mortality and serious injury between 10% and 50% of PBR	No measurable population change For marine mammals, mortality and serious injury less than or equal to 10% of PBR
	Geographic extent	Distributed across range of a population	Distributed across several areas identified to support vital life phase(s) of a population	Localized to one area identified to support vital life phase(s) of a population or non-vital areas
	Frequency and duration	Chronic or constant and lasting up to several months or years (long-term)	Periodic or intermittent and lasting from several weeks to months (intermediate)	Occasional or rare and lasting less than a few weeks (short-term)
	Likelihood	Certain	Probable	Possible
Social and Economic Environment	**Magnitude or intensity**	Large, acute, or obvious changes that are easily quantified	Small but measurable changes	No measurable changes
	Geographic extent	Affects region (multiple states)	Affects state	Affects local area
	Frequency and duration	Chronic or constant and lasting up to several months or years (long-term)	Periodic or intermittent and lasting from several weeks to months (intermediate)	Occasional or rare and lasting less than a few weeks (short-term)
	Likelihood	Certain	Probable	Possible

[1] Potential Biological Removal (PBR).

4.1.1 Impact Criteria for Marine Mammals

Following the approach used in the 2016 PEA to analyze potential effects of fisheries and ecosystem research on marine mammals, SPEA Alternatives 1 and 2 are evaluated using two factors, PBR and the categorization of commercial fisheries with respect to their adverse interactions with marine mammals.

Regarding the first factor, PBR is defined in the MMPA (16 U.S.C. § 1362(20)) as, "the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population." PBR is intended to serve as an upper limit guideline for fishery-related mortality for each species. Calculations of PBR are stock-specific and calculated as the product of the estimate of the minimum population size, reproductive potential of the species, and a recovery factor related to the conservation status of the stock (e.g., whether the stock is listed under the ESA or depleted under the MMPA). NMFS is required to calculate PBR (if possible) for each marine mammal stock under their jurisdiction and report PBR in the annual marine mammal SARs mandated by the MMPA. The PBR metric has been used extensively to assess human impacts on marine mammals in many situations involving M/SI and is recognized as an acceptable metric used by NMFS Office of Protected Resources (OPR) in the evaluation of incidental takes of marine mammals from commercial fisheries in U.S. waters.

Regarding the second factor, NMFS classifies all U.S. commercial fisheries into one of three categories based on the level of marine mammal M/SI that occurs incidentally to each fishery, as published in the annual List of Fisheries (LOF)[7]. Category III fisheries are considered to have a remote likelihood of or no known incidental M/SI of marine mammals. Category II fisheries are those that have occasional incidental M/SI of marine mammals. Category I fisheries are those that have frequent incidental M/SI of marine mammals. These commercial fisheries categories are used as proxies for NEFSC fisheries and ecosystem research as a way to evaluate potential interactions with marine mammals during surveys.

As shown in Table 4-1, if projected annual M/SI of a marine mammal stock from NEFSC research is less than or equal to 10 percent of PBR for that stock, the effect would be minor in magnitude (similar to the LOF's Category III fisheries that have a remote likelihood of measurable population change). Estimated annual M/SI from NEFSC research between 10 and 50 percent of PBR for that stock would be moderate in magnitude, similar to the LOF's Category II fisheries where population effects may be measurable. Similar to LOF Category I fisheries that have frequent M/SI of marine mammals, NEFSC research that could result in annual M/SI greater than 50 percent of PBR would be considered a major effect due to potential impacts on a stock's population. Note that NEPA requires several other components to be considered for impact assessments (see Table 4-1); the magnitude of impact is not necessarily the same as the overall impact assessment in a NEPA context.

This assessment estimates possible M/SI using the commercial fisheries classifications as a proxy for NEFSC research takes. This assessment of SPEA Alternatives 1 and 2 also provides a comparison of actual marine mammal takes during the period 2016–2019. Actual takes that occurred during this period

[7] https://www.govinfo.gov/content/pkg/FR-2021-01-14/pdf/2021-00570.pdf

represent the Status Quo/No Action (Alternative 1). This comparison, together with the fisheries classifications used to project takes during future NEFSC research (2021-2026) represents Alternative 2.

In addition to this SPEA, an application for potential incidental harassment of marine mammals associated with future NEFSC research (2021-2025) is being prepared pursuant to Section 101(a)(5)(A) of the MMPA (see Section 1.2). The MMPA LOA application estimated takes for each marine mammal stock that may occur due to NEFSC research. In the SPEA assessment as well as the MMPA LOA application, NEFSC research is grouped by gear type (i.e., trawl gear and dredge gear), not by individual research activities (e.g., by survey). This precludes impact analysis of each individual survey or project and instead provides a basis for understanding interactions between specific gear used and marine mammals that may occur in a designated research area.

To evaluate potential cumulative effects on marine mammals, the contribution of NEFSC research is evaluated in combination with past, present, and reasonably foreseeable future actions and events that may impact marine mammals (i.e., commercial fisheries and climate change). Potential cumulative effects presented in Chapter 5 have been analyzed using the same impact assessment criteria and thresholds as described in Table 4-1, only they consider the collective sources of M/SI and other types of impacts on marine mammals.

4.1.1.1 Disturbance and Behavioral Responses Due to Acoustic Equipment

Several mechanisms exist by which research activities could potentially disturb marine mammals and alter behavior, including the physical presence of human activities (i.e., vessels or field crews on land), fishing gear, underwater sound from engines, hydraulic gear, or acoustical devices used for navigation and research. Marine mammals rely on sound to obtain detailed information about their surroundings, communicate, navigate, reproduce, socialize and avoid predators. Thus, the surrounding soundscape is a key component of marine mammal habitat and can be considered their acoustic habitat (Clark *et al.* 2009). Underwater sound comes from numerous natural sources (biological and physical processes) and anthropogenic sources. Biological sounds include marine life (marine mammals, fish, snapping shrimp). Physical sounds include wind and wave activity, rain, cracking sea ice, undersea earthquakes and volcano eruptions. Anthropogenic sound includes shipping and other vessel traffic, military activity, marine construction, oil and gas exploration and more. Some of these natural and anthropogenic sounds are present more or less everywhere in the ocean all of the time. Therefore, background sound in the ocean is commonly referred to as “ambient noise” (DOSITS 2020). Sound levels at a given frequency and location can vary by 10-20 decibels (dB) from day to day (Richardson *et al.* 1995). The result is that, depending on the source type and its intensity, sound from a specified activity may be a negligible addition to the local soundscape or could form a distinctive signal that may affect marine mammals.

The impacts of anthropogenic noise on marine mammals have been summarized in numerous, books, articles and reports including Richardson *et al.* (1995), National Research Council NRC (2005), Southall *et al.* (2007) and Southall *et al.* (2019). Marine mammals use hearing and sound transmission to perform vital life functions. The distance to which anthropogenic sounds are audible depends on the level of ambient noise, anthropogenic sound source levels, frequency, ambient noise levels, the propagation characteristics of the environment, and sensitivity of the marine mammal (Richardson *et al.* 1995). Marine mammals exposed to high intensity sound repeatedly or for prolonged periods could experience

hearing threshold shift, resulting in the loss of hearing sensitivity at certain frequency ranges (Kastak *et al.* 1999, Schlundt *et al.* 2000, Finneran *et al.* 2002, Finneran *et al.* 2005). Threshold shift results in permanent threshold shift (PTS), where lost hearing sensitivity is unrecoverable, or temporary threshold shift (TTS), in which case an animal may recover hearing sensitivity over time (Southall *et al.* 2007).

In 2019, Southall *et al.* (2019) published an update to the 2007 Marine Mammal Noise Exposure Criteria, proposing eight discrete hearing groups including: 1) low frequency cetaceans; 2) high frequency cetaceans; 3) very high frequency cetaceans; 4) sirenians; 5) phocid carnivores in water; 6) phocid carnivores in air; 7) other marine carnivores in water; and 8) other marine carnivores in air (Southall *et al*. 2019). While the 2019 publication considers more recent studies conducted since 2007 to better understand marine mammal hearing, the 2018 revised NMFS Technical guidance continues to be used for defining regulatory thresholds for calculating incidental takes of marine mammals under the MMPA. For this reason, the thresholds used in this SPEA and the MMPA LOA application are based on the 2018 revised NMFS guidance (NMFS 2018b).

The *Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing* NMFS (2018b) uses marine mammal hearing groups defined by Southall *et al.* (2007) with some modifications. These groups and their generalized hearing ranges are shown in Table 4-2. As shown on the table, marine mammals found in the NEFSC research areas fall into the following categories: baleen whales are low-frequency cetaceans; killer whales are mid frequency cetaceans; Atlantic spotted dolphins and harbor porpoise are high frequency cetaceans; gray seals are in the phocid category; and sea lions are classified as otariids. There are no otariid species that occur in NEFSC research areas. NMFS (2018b) considered acoustic thresholds by hearing group to acknowledge that not all marine mammals have identical hearing ability or identical susceptibility to noise or noise-induced PTS. NMFS (2018b) also used the hearing groups to establish marine mammal auditory weighting functions (Table 4-3).

Although the 2018 guidance identifies dual criteria to assess auditory injury (Level A harassment) to five different marine mammal groups (based on hearing sensitivity) as a result of exposure to noise from two different types of sources (impulsive or non-impulsive), given the highly directional, e.g., narrow beam widths of acoustic equipment, NMFS does not anticipate animals would be exposed to noise levels resulting in injury. Potential effects of underwater noise on marine mammals have been evaluated for NEFSC research alternatives and are presented in the 2016 PEA and supplemented in this chapter as needed.

TABLE 4-2. GENERALIZED HEARING RANGES FOR MARINE MAMMAL HEARING GROUPS IN WATER

Hearing Group	Hearing Range
Low-frequency cetaceans (*e.g.* baleen whales)	7 Hz to 35kHz
Mid-frequency cetaceans (*e.g.* killer whales)	150 Hz to 160 kHz
High-frequency cetaceans *(e.g.* Atlantic spotted dolphins)	275 Hz to 160 kHz
Phocids (*e.g.* gray seals)	50 Hz to 86 kHz
Otariids and other non-phocid marine carnivores (*e.g.* sea lions)	60 Hz to 39 kHz

Source: NMFS (2018b).

TABLE 4-3. SUMMARY OF WEIGHTING AND EXPOSURE FUNCTION PARAMETERS

Hearing Group	a	b	f_1 (kHz)	f_2 (kHz)	K (dB)
Low-frequency cetaceans	1.0	2	0.20	19	0.13
Mid-frequency cetaceans	1.6	2	8.8	110	1.20
High-frequency cetaceans	1.8	2	12	140	1.36
Phocids in water	1.0	2	1.9	30	0.75
Otariids in water	2.0	2	0.94	25	0.64

Source: NMFS (2018b).

Animals exposed to natural or anthropogenic sound may experience physical and behavioral effects, ranging in magnitude from none to severe (Southall *et al.* 2007). Watkins (1986; as reported in (NRC 2003) suggests that contextual factors influence whether or not a marine mammal becomes habituated to a particular disturbance or stimuli. For example, animals may tolerate a stimulus they might otherwise avoid if the benefits in terms of feeding, mating, migrating to traditional habitat, or other factors outweigh the negative aspects of the stimulus.

The actual radius of a behavioral effect is smaller than the radius of noise detectability (Richardson *et al.* 1995, Southall *et al.* 2007). As an example, during spring migration, bowheads were shown to continue through an area where the only available lead was within 200 m of a projector playing sounds associated with a drilling platform that produced received levels of 131 dB re 1 microPascal (µPa) (Richardson *et al.* 1991 as reported in NRC 2003). NMFS currently uses a behavioral threshold of 120 dB root mean square (rms) for continuous noise sources (i.e., echosounder EK60 used in fisheries surveys) and 160 dB rms for impulsive noise sources. These interim behavioral effect thresholds as applied by NMFS do not account for differences between species in hearing ranges and sensitivity to noise at different frequencies and are based on broadband unweighted sound levels.

These thresholds are conservative considering that many natural and anthropogenic noise sources can cause noise levels above these thresholds but not necessarily result in adverse behavioral effects to marine mammals (Table 4-4). TTS is by definition recoverable rather than permanent and is treated as ‘‘Level B harassment’’ under the MMPA.

TABLE 4-4. ACOUSTIC THRESHOLDS FOR LEVEL A INJURY

Hearing Group	PTS Onset Acoustic Thresholds (Received Level)		
	Impulsive Sources		Non-impulsive Sources
	Peak, L_{pk}, flat (dB re 1 µPa)	Cumulative weighted SEL_{24h} (dB re 1 µPa²·s)	Cumulative weighted SEL_{24h} *(dB re 1 µPa²·s)*
Low-frequency cetaceans	219	183	199
Mid-frequency cetaceans	230	185	198
High-frequency cetaceans	202	155	173
Phocid pinnipeds in water	218	185	201
Otariid pinnipeds in water	232	203	219

Source: NMFS (2018b).
Notes: Peak sound pressure is "flat" or unweighted. Cumulative sound exposure level has a reference value of 1µPa2s. Cumulative levels should be appropriately weighted for the hearing group for assessment to the threshold.

4.2 Mitigation Measures

By definition, mitigation means to "make less severe or intense; moderate or alleviate." The U.S. CEQ provided guidance in 1981 stating:

> "Mitigation measures discussed in an EIS must cover the range of impacts of the proposal. The measures must include such things as design alternatives that would decrease pollution emissions, construction impacts, esthetic intrusion, as well as relocation assistance, possible land use controls that could be enacted, and other possible efforts. Mitigation measures must be considered even for impacts that by themselves would not be considered "significant." Once the proposal itself is considered as a whole to have significant effects, all of its effects on the environment (whether or not "significant") must be considered, and mitigation measures must be developed where it is feasible to do so (CEQ 1981)."

Proposed mitigation measures organized by gear type for SPEA alternatives are listed in Table 2-3 and organized by gear type. Specific measures to reduce potential interaction with resources evaluated in detail in this chapter are discussed in the following sections where applicable.

4.2.1 Atlantic Salmon

NEFSC fisheries research has little direct interaction with the ESA-listed GOM population of Atlantic salmon. Directed research in Greenland is the primary interaction between NEFSC research and this species, although the likelihood of incidentally capturing ESA-listed fish is considered low (Jeffery *et al.* 2018).

The most significant mitigation and protection measure taken to improve the number of healthy salmon returning to U.S. rivers was the closure of the commercial fisheries in West Greenland. In May 2018, the ASF and the NASF signed an agreement with commercial fishermen in Greenland and the Faroe Islands to protect adult wild Atlantic salmon from commercial nets and longlines. The new Greenland Salmon

Conservation Agreement closes commercial fishing for salmon for a period of 12-years (2018-2029) and will increase the number of salmon returning to their natal rivers in North America and Europe. This was one of three significant actions identified in the Action Plan that would benefit the species by reducing to the maximum extent possible harvest of U.S. origin salmon and by increasing the marine survival and number of healthy adult returns to U.S. streams.

4.2.2 Giant Manta Rays

Based on previous NEFSC research activities, it is not anticipated that any rays would be captured during the proposed research. However, if a ray is incidentally captured, it should be released quickly but with care and kept in the water to the maximum extent possible. These mitigation measures are based on Carlson et al. (2018), and while specifically developed for *Mobulidae* species, are generally applicable to all rays and sharks. Mitigation measures specifically for giant manta rays are new since 2016 and include the following for rays caught during any survey:

- Make every effort to disentangle the animal from the gear.
- If possible to do without causing injury, use the gear (i.e., netting, line and leader, etc.) to maneuver the ray alongside the vessel to disentangle while fully submerged to keep the ray in the water.
- Do not cut off the tail.
- Do not gaff the animal.
- Do not lift, drag or carry the ray by the gill slits or cephalic lobes.
- Do not punch holes through the body to pass hoisting cables through it or bind wire around the animal to move it.
- Bringing a Ray Onboard a Vessel: If it is not possible to remove the netting while the animal is in the water, carefully bring it on board without causing damage to the body by supporting at least two points of contact or preferably have two to three people carry the ray (specifically for *Mobulidae* species) by the sides of each wing.

For manta rays caught during longline surveys follow the steps above for all surveys plus:

- Use the line and leader to maneuver the animal alongside the vessel.
- Do not attempt to pull hooks out until assessing whether it can be done safely. If the ray is hooked through the mouth with a barbed hook, it can be safely dislodged by using a turtle dehooker or cutting the hook below the barb with bolt cutters.
- If the hook has been swallowed, or “foul hooked” (i.e., any place but the jaw), do not try to retrieve the hook. Cut the leader as close to the hook as possible and release.
- Animals should be released with no or little to no trailing line or hook.
- To release from onboard a vessel: Have two or three people (especially for *Mobulidae* species) carry each wing and release ray over the side of the vessel.

4.2.3 North Atlantic Right Whales

NEFSC-affiliated research vessels follow mitigation measures which were implemented to minimize the risk of vessel collisions with right whales. Specifically, if NEFSC vessels are operating in right whale

Seasonal Management Areas, Dynamic Management Areas, or at times and locations when North Atlantic right whales are otherwise known to be present, they will operate at speeds no greater than 10 knots.

4.3 Direct and Indirect Effects of the Status Quo/No Action (2016-2019)

This section describes the results of a focused assessment of research that occurred between 2016 and 2019 (i.e., Status Quo) on resources identified in Chapter 3. For example, the assessment of potential effects of NEFSC fisheries and ecosystem research on scallop bycatch during fisheries surveys for the period 2016–2019 is presented herein. This section also presents a comparison of the number of marine mammal incidental takes that occurred 2016–2019 to what was requested in the 2016 LOA application.

4.3.1 Effects on the Physical Environment

Table 4-5 summarizes potential effects of the Status Quo/No Action Alternative on elements of the physical environment that have been added or updated since the 2016 PEA. Potential environmental consequences on these elements are described in Table 4-5 and have been updated based on actions described for the new Status Quo alternative and newly available information presented in Table 3-1. Overall, NEFSC research would be expected to contribute to a better understanding of physical resources within research areas and the effects of recent conservation and management regimes (i.e., Amendment OH2 for EFH). For example, the research would help better understand biological rates of change of the community (i.e., growth rate and recovery rate) and possibly whether those changes are human-induced or naturally occurring.

TABLE 4-5. SUMMARY OF POTENTIAL IMPACTS OF THE STATUS QUO/NO ACTION ALTERNATIVE ON THE PHYSICAL ENVIRONMENT

Special Resource Area	Potential Impact of Status Quo/ No Action Alternative	Description
Essential Fish Habitat ***Stellwagen Bank DHRA***	Minor *Beneficial*	The combination of new and revised EFH conservation areas, habitat management areas and creation of habitat research areas (DHRAs) implemented due to Amendment OHA2 is anticipated to minimize adverse impacts to EFH from the effects of fishing. The recent court settlement to ban gillnetting in two areas will also further protect EFH. While OHA2 reopened some locations to commercial fishing (i.e., Nantucket Lightship and Closed Area 1), the overall effects are expected to be balanced by ***beneficial*** effects due to this change**.**
Closed Areas	Minor *Beneficial*	See EFH above.
National Marine Sanctuaries ***Monitor NMS Boundary Expansion***	Minor *Beneficial*	In 2016, ONMS published a notice of intent to expand boundaries of the sanctuary. The expansion could preserve nationally significant historic wreck sites which would also likely benefit physical resources. However, the expansion is still only a proposal and has not been implemented.

4.3.1.1 Summary of Effects on the Physical Environment

Overall, the effects of recent changes to regulatory regimes in the NEFSC research areas are expected to result in minor beneficial effects on physical resources. The proportion of research sampling and biomass removals made within Stellwagen Bank NMS based on the annual number of research trawls conducted within the Sanctuary and the removals of fish and invertebrates for scientific purposes are relatively small, therefore any adverse effects on the Sanctuary would be temporary and minor. There are potential benefits from research that may outweigh any minor adverse effects such as a better understanding of growth and recovery rates of physical resources.

4.3.2 Effects on the Biological Environment

ESA-listed fish, target fish, ESA-listed marine mammals, non-listed marine mammals, sea turtles, and invertebrates are considered in the following subsections. As described in Sections 3.2.3, seabirds did not change sufficiently to warrant re-analysis in this SPEA.

4.3.2.1 Effects on Fish

Section 3.2.1 describes fish species, including those listed under the ESA, that occur in NEFSC research areas. As shown in Section 3.2.1 and Tables 3-3 through 3-6, not all fish species require re-evaluation under the SPEA proposed alternatives because the potential impacts are expected to be the same as documented in the 2016 PEA (NMFS 2016b). Only species potentially affected by the changed scope of activities, or species with a significant change in status are evaluated in the following subsections. The potential effects of climate change may influence the overall health of fish species and their habitats throughout NEFSC research areas. To address this issue, NOAA scientists applied a new methodology to assess the climate vulnerability of 82 fish (and invertebrate species) in the Northeast region (https://www.st.nmfs.noaa.gov/ecosystems/climate/northeast-fish-and-shellfish-climate-vulnerability/index). An overview of the results of this study are presented in Section 5.2.3 of this SPEA within the context of potential cumulative effects of climate change.

4.3.2.1.1 ESA-Listed Species

Table 4-6 brings forward ESA-listed fish species identified in Table 3-3 as requiring further evaluation and summarizes the potential effects of the Status Quo/No Action Alternative on these species.

TABLE 4-6. SUMMARY OF POTENTIAL IMPACTS OF THE STATUS QUO/NO ACTION ALTERNATIVE ON ESA-LISTED FISH SPECIES

ESA-Listed Species	Potential Impact of Status Quo/No Action Alternative		Description
	Mortality from Surveys	**Disturbance Due to Sound Sources**	
Atlantic Salmon, GOM DPS (E)	Minor *Adverse*	No effect	No change in ESA-listed status. The directed commercial fishery for Atlantic salmon in West Greenland ended in 2018 which will increase survival primarily in Canada, but also the GOM DPS. Tagging research project in Greenland by NEFSC takes up to 100 fish a year by trolling which are not necessarily ESA-listed fish. The recent tagging studies resulted in only one salmon tagged from ESA-listed populations suggesting that impacts from the Greenland study and total takes from the GOM DPS would be expected to be a minor adverse effect.
Atlantic Sturgeon ***GOM southern DPS (T)*** ***All other DPSs (E)***	Minor *Adverse*	No effect	On Aug 17, 2017, critical habitat was designated or all DPSs. Incidental takes have occurred (Table 4-7), but none were lethal.
Shortnose Sturgeon	Minor *Adverse*	No effect	Shortnose sturgeon have not been historically taken during surveys (NMFS 2016a). However, future catch of this species during trawl or fyke net surveys in coastal areas such as the Penobscot and Hudson River estuaries is possible. Effects would be minor adverse.
Giant Manta Rays	Minor *Adverse*	No effect	Giant manta rays are targeted and caught as bycatch, with high rates of removal from industrial purse-seine and artisanal gillnet fisheries (83 FR 2916). These mortalities generally occur outside the proposed Research areas but future catch is possible. Therefore, NEFSC research may, but is not likely to incidentally catch giant manta rays during research. Effects would be minor adverse.

Mortality from Surveys

Atlantic Salmon

To obtain information on the migration dynamics of marine phase Atlantic salmon, NMFS NEFSC biologists initiated a pilot marine tracking program in 2018. The intent was to capture Atlantic salmon while trolling using rod and reel along the inshore areas of West Greenland. During the project in West Greenland near Qaqortoq in October 2018, a total of 17 Atlantic salmon were captured, primarily via trolling, and tagged with PSATs (Microwave Telemetry Inc. X-tags) (ICES 2019). The tagging project study area includes a portion of the marine range of Atlantic salmon in the North Atlantic as salmon originating in both North America and Europe. Future research includes trolling over a 30-day (maximum) period during the months of September and October. The fishing season for Atlantic salmon in Greenland is August to October. The fish grow very quickly during that time, so focusing tagging efforts later in the season means obtaining bigger fish to tag. The intent is to capture and tag a maximum of 100 pre-adult individuals a year, although 30 to 50 fish per year is considered a more likely capture range.

Jeffery *et al.* (2018) conducted genetic testing for all fish tagged to determine the region of origin; six individuals were identified as North American origin and six were identified as European origin. For salmon identified as North American, one originated from the USA reporting group, four from the Canadian Gaspe Peninsula reporting group, and one from the Canadian Ungava Bay reporting group. Two fish were also tagged with acoustic tags. Both acoustic tagged fish have been identified as coming from the Labrador South and Gaspe Peninsula reporting groups in North America (ICES 2019). The 2016 BiOp for Status Quo research anticipated up to five GOM DPS Atlantic Salmon incidentally taken (two lethal). Considering the salmon taken in the 2018 surveys by NEFSC were not identified as coming from North American DPSs, the effects of Status Quo research is considered minor adverse.

Atlantic Sturgeon

As shown in Table 4-7, non-lethal Atlantic sturgeon takes have occurred on a regular basis during NEFSC bottom trawl surveys and the NEAMAP studies. The total annual nonlethal takes are well below the 2016 BiOp anticipated incidental take of up to 595 Atlantic sturgeon from five DPSs (NMFS 2016a), and the effects of NEFSC research under the Status Quo alternative is considered minor adverse.

As shown in Figure 4-1, the bulk of these interactions in 2017and 2018 were during the inshore NEAMAP survey close to estuaries (Figure 4-1). These NEAMAP surveys encountered more Atlantic sturgeon than available tags and sampling vials, and sampling and tagging were some missing from those two programs. This situation was solved with more supplies and training in 2019.

TABLE 4-7. ATLANTIC STURGEON TAKES DURING NEFSC SURVEYS 2008 TO 2019

Year	Number Killed	Released Alive Injured	Released Alive Uninjured	Total Taken	Survey
2008	0	0	2	2	NEAMAP ME/NH
2009	0	0	3	3	NEAMAP ME/NH
2010	0	0	2	2	NEAMAP ME/NH
2011	0	0	2	2	NEAMAP ME/NH
2012	0	0	33	33	5 – BTS spring 6 – NEAMAP ME/NH 22 – NEAMAP VIMS
2013	0	0	17	17	1 – BTS spring 2 – NEAMAP ME/NH 14 – NEAMAP VIMS
2014	0	0	2	2	NEAMAP ME/NH
2015	0	0	6	6	2 – BTS spring 4 – NEAMAP ME/NH
2016	0	0	3	3	BTS spring
2017	0	0	25	25	4 – BTS spring 20 – NEAMAP VIMS 1 – NEFOP gillnet training
2018	0	0	62	62	1 – BTS spring 6 – NEAMAP ME/NH 54 – NEAMAP VIMS 1 – NEFOP gillnet training
2019	0	0	35	35	2 – BTS spring 31 – NEAMAP VIMS 1 – NEFOP trawl training 1 – Twin Trawl Sweep Comparison

Source: NMFS PSIT database

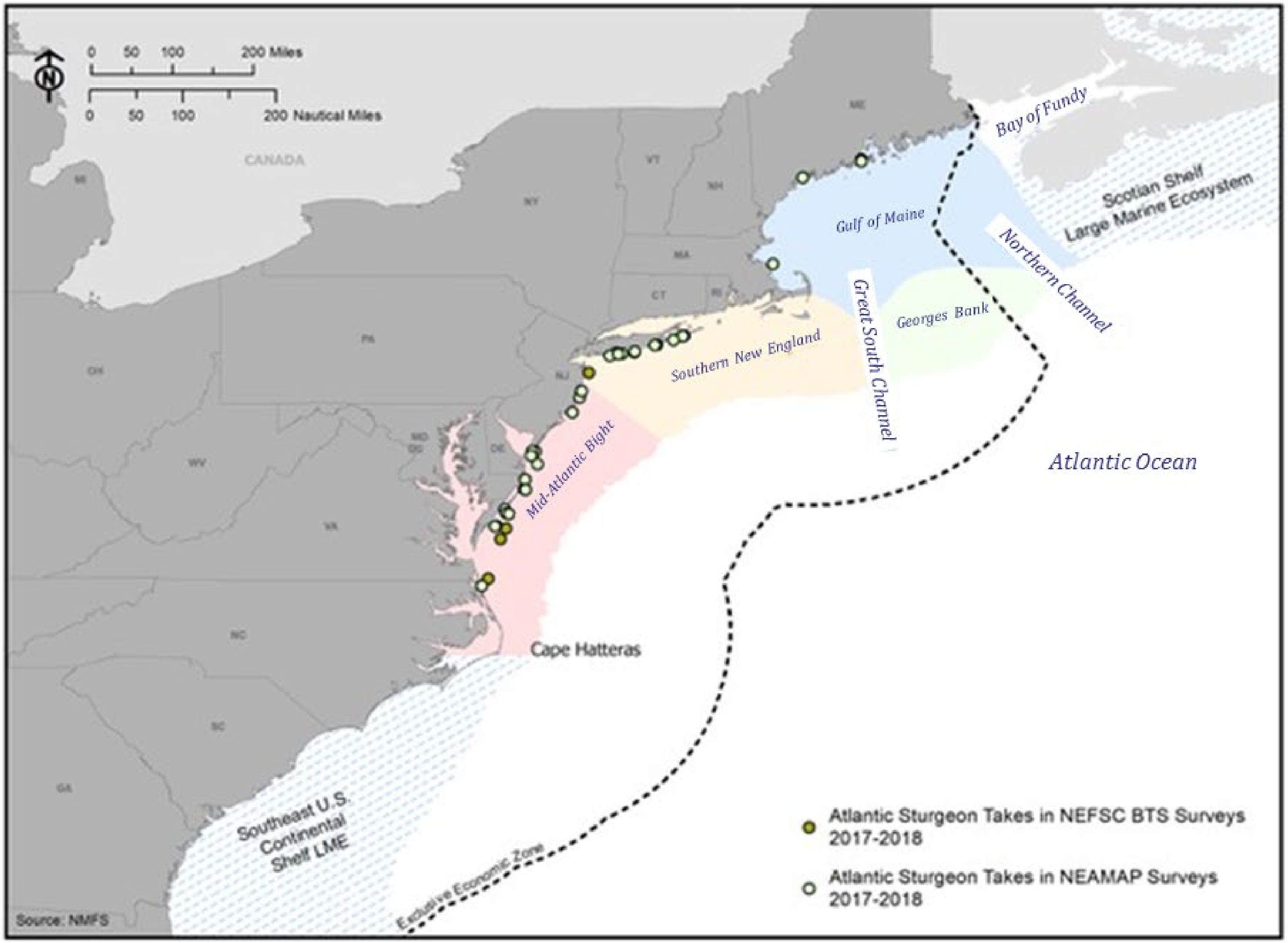


FIGURE 4-1. LOCATION OF ATLANTIC STURGEON TAKES 2017 AND 2018

Shortnose Sturgeon

To date, shortnose sturgeon have not been captured in the NEFSC bottom/mid-water trawl or sea scallop dredge surveys (NMFS 2016a). However, future catch of this species during NEFSC research is possible and would most likely occur during trawl or fyke net surveys in coastal areas such as the Penobscot and Hudson River estuaries. Therefore, fisheries research is likely to adversely affect shortnose sturgeon. Because minimal interaction is expected, effects would be minor adverse.

Giant Manta Ray

Demand for manta ray gills and other manta ray products parts in Asian markets is the most significant threat for this species. Available data reviewed by Oliver et al. (2015); as cited in Miller and Klimovich (2017), revealed that manta rays comprised the highest proportion of ray bycatch (specifically Giant manta rays) in purse seine fisheries in the Indian Ocean (especially the Eastern Pacific Ocean). Bycatch in longline, trawl or gillnet fisheries was not large in any ocean basin (NMFS 2016a). Bycatch of manta rays from fisheries operating primarily in the Central and Western Pacific Ocean, includes the U.S. tuna purse seine fisheries, Hawaii-based deep-set longline fisheries targeting tuna, and American Samoa pelagic longline fisheries.

Information on population sizes and distribution of giant manta rays in the Atlantic is lacking. While giant manta rays in the Atlantic have been confirmed as far north as offshore around the Hudson Canyon region near Long Island, New York (Normandeau Associates and APEM Ltd 2017; as cited in 84 FR 66652), this species is considered rare north of Cape Hatteras, North Carolina. Bycatch of giant manta rays in the Atlantic Ocean has been observed in purse-seine, trawl, and longline fisheries; however, as was noted in a study by Oliver et al. (2015); as cited in Miller and Klimovich (2017), based on the available data, *M. birostris* does not appear to be a significant component of the bycatch. *M. birostris* also seems to be a rare occurrence in the elasmobranch catch in the U.S. bottom longline and gillnet fisheries operating in the western Atlantic. Bycatch of manta rays is low since implementation of Amendment 2 to the Consolidated Atlantic Highly Migratory Species Fishery Management Plan (NMFS 2007 as cited in 84 FR 66652). Data from the NMFS shark bottom longline observer program between 2005 and 2014, document only two giant manta caught by bottom longline vessels fishing in the Gulf of Mexico and South Atlantic. One of these animals was discarded alive and one kept (based on 214 observed vessels, 833 trips, and 3,032 hauls [84 FR 66652]). Based on NEFOP data for the period 2015 through 2019, two unidentified rays were observed in gillnet gear (both in 2015) which were conservatively assumed to have been giant manta rays. In all four cases, these animals were encountered off North Carolina, were captured alive, and then released alive.

Considering the distribution and volume of NEFSC research is much lower than commercial fisheries, giant manta rays may be but are not are not likely to be caught incidentally during NEFSC surveys. For this reason, NEFSC research may affect but is not likely to adversely affect giant manta rays.

Disturbance and Changes in Behavior due to Sound Sources

Underwater sound comes from numerous natural sources (biological and physical processes) and anthropogenic sources. Biological sounds include marine life (marine mammals, fish, snapping shrimp). Physical sounds include wind and wave activity, rain, cracking sea ice, undersea earthquakes and volcano eruptions. Anthropogenic sound includes shipping and other vessel traffic, military activity, marine construction, oil and gas exploration and more. Some of these natural and anthropogenic sounds are present more or less everywhere in the ocean all of the time. Therefore, background sound in the ocean is commonly referred to as “ambient noise” (DOSITS 2020).

The sound level of a region is defined by the total acoustical energy being generated by known and unknown sources. In general, ambient sound levels tend to increase with increasing wind speed and wave height. Precipitation can be an important component of total sound at frequencies above 500 Hertz (Hz) and possibly down to 100 Hz during quiet times. Some fish and snapping shrimp can contribute significantly to ambient sound levels, as can marine mammals. The frequency band for biological contributions is from approximately 12 Hz to over 100 kHz. In deep water, low-frequency ambient sound from 1-10 Hz mainly comprises turbulent pressure fluctuations from surface waves and the motion of water at the air-water interface. At these frequencies, sound levels depend only slightly on wind speed. Between 20-300 Hz, distant ships transiting dominates wind-related sounds. Above 300 Hz, the ambient sound level depends on weather conditions, with wind- and wave-related effects mostly dominating the soundscape. Vessel noise typically dominates the total ambient sound for frequencies between 20 and 300 Hz. In general, the frequencies of anthropogenic sounds are below 1 kHz and, if higher frequency sound levels are created, they attenuate rapidly.

Physiological effects of noise on fish includes potential auditory distortion however, this type of effect has been associated with underwater sound sources not used during NEFSC surveys such as seismic air guns or pile driving (Lokkeborg *et al.* 2012). Schools of sprat and Atlantic mackerel have been shown to response to sound pressure levels 163.2 and 163.3 dB peak-to-peak, respectively, approximately 50% of the time when exposed. Daytime exposure when fish were aggregated into schools initiated a response to sound, but these fish did not respond at night, when fish schools were broken up and individual fish were dispersed (DOSITS 2020).

Generally, most acoustic sources used in NEFSC and NEFSC-affiliated research vessels are inaudible to fishes or pose no hearing threat. One possible exception to this are some species in the herring family which have been shown to respond to frequencies up to 200 kHz (DOSITS 2020). However, these few acoustical devices that are audible and that could cause avoidance disturbance, would be minor in intensity, occur over a local geographic extent, and the duration would be temporary. Echosounders have variable source levels typically ranging between 185 dB to 230 dB re 1μPa at 1m. Most fishes do not hear in the frequencies used by echosounders with the exception, possibly, of some species in the herring family which have been shown to respond to frequencies up to 200 kHz (DOSITS 2020). Changes in fish behavior due to sounds might range from momentary awareness of the sound, to small movements, or escape responses. The degree of behavioral response would indicate how significant it may be on a particular fish species or individual and may not be biologically significant (DOSITS 2020).

Fish may also respond to approaching vessels by diving towards the seafloor or moving horizontally out of the vessel's path; however, the variable stimuli these fish may react to are not always clear (Kaplan and Mooney (2015 as cited in (Popper *et al.* 2019). Popper *et al.* (2019) reported there may be some frequency overlap between vessel noise and fish hearing, resulting in masking sounds vital to important biological functions such as feeding or territorial defense. Many studies on vessel noise and fish behavior cited in Popper *et al.* (2019) reported some evidence of changes in behavior however, these studies were of areas where vessel traffic was likely more frequent than NEFSC surveys would occur (i.e., in areas where regular recreational or commercial traffic occurs). Kaplan *et al*. (2016 as cited in (Popper *et al.* 2019) emphasized the need for both targeted and long-term acoustic monitoring studies to evaluate the potential for effects of noise on aquatic organisms, including fish. Overall, disturbance and changes in fish behavior are expected to be short-term and not result in biologically significant changes to fish populations. Therefore, NEFSC research is expected to have no effect on fish behavior.

Mitigation Measures to Reduce Atlantic Salmon Bycatch

The Atlantic Salmon 5-Year Action Plan (NMFS 2016c) highlighted the actions that can be taken by NOAA, other federal and state resource agencies, environmental organizations, Native American Tribes and other partners to turn the trend around for this species from a declining trajectory to a trajectory towards recovery. Globally, the largest impact and most significant recovery/mitigation measure in the marine environment (excluding dam removals, enhancement of spawning rivers in northeast) in recent years was the closure of commercial fisheries in West Greenland. While other actions are needed to address spawning rivers and habitat, NEFSC fisheries research in the NE LME has little direct interaction with the ESA-listed GOM population of Atlantic salmon. Directed research in Greenland is the primary interaction between NEFSC research and this species, although the likelihood of incidentally capturing ESA-listed fish is considered to be low (Jeffery *et al.* 2018).

The most significant mitigation and protection measure taken to improve the number of healthy salmon returning to U.S. rivers was the closure of the commercial fisheries in West Greenland. In May 2018, the ASF and the NASF signed an agreement with commercial fishermen in Greenland and the Faroe Islands to protect adult wild Atlantic salmon from commercial nets and longlines. The new Greenland Salmon Conservation Agreement closes commercial fishing for salmon for a period of 12-years (2018-2029) and will increase the number of salmon returning to their natal rivers in North America and Europe. This was one of three significant actions identified in the Action Plan that would benefit the species by reducing to the maximum extent possible harvest of U.S. origin salmon and by increasing the marine survival and number of healthy adult returns to U.S. streams.

Summary of Effects on ESA-Listed Fish

The 2016 BiOp for NEFSC fisheries research accounted for the possibility of incidentally capturing 595 Atlantic sturgeon during surveys and up to five GOM DPS Atlantic Salmon (two lethal). Incidental capture of Atlantic sturgeon ranged from 4–10% in 2017 and 2018, respectively. This low level of catch is considered minor and not likely to result in significant effects on the population. Considering most acoustic tagged fish during 2018 surveys were identified as coming from non-ESA-listed reporting groups (Labrador South and Gaspe Peninsula) (ICES 2019), the effect of Status Quo research is considered minor adverse for Atlantic salmon.

Potential Effects on Designated Critical Habitat for ESA-listed Fish

NEFSC research activities in the Penobscot estuary and inshore area overlap with designated critical habitat for the GOM DPS of Atlantic salmon and for Atlantic sturgeon. There is no critical habitat in the marine environment where the majority of NEFSC research occurs for either species. NEFSC surveys using pelagic trawls, fyke nets and hydroacoustics take place in the Penobscot estuary. As described in the 2016 BiOp (NMFS 2016a) for Atlantic salmon, research activities will not result in a migration barrier as the surveys will only affect small portions of specific rivers and estuaries at any given time, and because no salmon will be prevented from passing through the Action Area. The research activities will not alter the habitat in any way that would increase the risk of predation, as all research in Maine rivers and estuaries involves low impact gear and nets. Therefore, NEFSC research may affect critical habitat but is not likely to destroy or adversely modify critical habitat for these species in the Penobscot River. Critical habitat has not been designated for shortnose sturgeon, oceanic whitetip sharks or giant manta rays.

4.3.2.1.2 Target and Other Fish Species

Table 4-8 shows the potential impacts of the Status Quo/ No Action Alternative on target and other fish species. In order to focus the assessment of the potential effects of research catches, this SPEA considers only those species listed as overfished, species for which overfishing is occurring or where a meaningful effect may be occurring (as indicated in Table 3-4). The 2016 PEA (Table 3.2-1) identified 35 target species encountered during NEFSC-affiliated research activities (2008–2012) that were listed as overfished or subject to overfishing at that time, or for which the average annual research catch exceeded 2,200 pounds (1.1 ton or 1 mt). For the 2016 PEA, the 2,200 pound threshold served as a basis of comparison against the amount of commercial and recreational catch for the purposes of analysis.

Since the 2016 PEA analysis, the list of target and other fish species analyzed herein has been expanded to include more species (i.e., species with research catch below the 2,200-pound threshold) or has been revised to break out specific stocks (i.e., windowpane flounder and yellowtail flounder) to provide a comprehensive evaluation of the potential effects of research on fish species. A table comparing levels of research catch to commercial and recreational catch is provided in Appendix B. Table 4-9 shows a subset of this analysis for species considered overfished, where overfishing is occurring or species brought forward for analysis as described in Chapter 3.

TABLE 4-8. SUMMARY OF POTENTIAL IMPACTS OF THE STATUS QUO/NO ACTION ALTERNATIVE ON NE LME TARGET FISH

Target Fish	Potential Impact of Status/Quo/No Action Alternative		Description
	Mortality from Surveys	Disturbance Due to Sound Sources	
Alewife (River herring)	Minor *adverse*	No Effect	No change in status; however, review for Alewife and Blueback Herring under the ESA (15 August 2017). Depleted status for the coast-wide meta-complex. Mortality from research surveys in 2017 (Table 4-9) was 88% of the total catch. Research catch has remained steady at around 3 tons over the period 2015-2017, but commercial catch dropped drastically.
Atlantic cod (GBK and GOM stocks)	Minor *adverse*	No Effect	Low level mortality from 2017 research surveys (Table 4-9) is a small percentage of the ACL and is not expected to result in adverse changes at the population level.
Atlantic halibut	Minor *adverse*	No Effect	Populations have been increasing, overfishing is not occurring. Low level mortality from 2017 research surveys (Table 4-9) is a small percentage of the ACL and is not expected to result in adverse changes at the population level.
Atlantic herring	Minor *adverse*	No Effect	Potential change in status; approaching overfished. 2017 research catch was 0.01% of total catch (Table 4.9).
Atlantic mackerel	Minor *adverse*	No Effect	Change in status. Overfished and overfishing is occurring. 2017 research catch was 0.07% of total catch but was higher than the 2008-2012 average of 0.02% (Table 4-9).
Atlantic wolffish	Minor *adverse*	No Effect	No change in status however the population is overfished. Low level mortality from research surveys (Table 4-9) is a small percentage of the ACL and is not expected to result in adverse changes at the population level.
Ocean pout	Minor *adverse*	No Effect	No change in status; continue rebuilding. Low level mortality from research surveys (Table 4-9) is a small percentage of the ACL and is not expected to result in adverse changes at the population level.
Red hake (southern stock only)	Minor *adverse*	No Effect	Change in status. Overfished and overfishing is occurring. 2017 research catch was about 0.5% of total catch, and less than the 2008-2012 percentage (Table 4-9)
Striped bass	No Effect	No Effect	Potential change in status. NEFSC (2019) states stock is overfished. 2017 research catch was less than 0.001% of total catch (Table 4-9).
Thorny skate	Minor *adverse*	No Effect	ESA status review published on February 24, 2017 concluded the thorny skate is not in danger of extinction and listing is not warranted.
Weakfish	Minor *adverse*	No Effect	Change in status. Stock is now considered depleted[1].

Target Fish	Potential Impact of Status/Quo/No Action Alternative		Description
	Mortality from Surveys	Disturbance Due to Sound Sources	
Windowpane flounder (GB and GOM stocks)	Minor *adverse*	No Effect	Change in status in 2016 from overfishing to no overfishing. Low level mortality from research surveys (Table 4-9) is a small percentage of the ACL and is not expected to result in adverse changes at the population level.
Winter flounder (blackback)	Minor *adverse*	No Effect	SNE/MAB stock: Overfished/overfishing; GOM stock: unknown. Low level mortality from research surveys (Table 4-9) is a small percentage of the ACL and is not expected to result in adverse changes at the population level.
Witch flounder (grey sole)	Minor *adverse*	No Effect	Potential change in status. Overfishing is currently unknown. Low level mortality from research surveys (Table 4-9) is a small percentage of the ACL and is not expected to result in adverse changes at the population level.
Yellowtail flounder	Minor *adverse*	No Effect	Change in status. All stocks are overfished and overfishing is occurring. Low level mortality from research surveys (Table 4-9) is a small percentage of the ACL and is not expected to result in adverse changes at the population level.

[1] ASMFC (2016) indicates weakfish has been depleted for the past 13 years. A fish stock is considered depleted when it falls below a spawning stock biomass threshold of 30%.

TABLE 4-9. RESEARCH CATCH OF TARGET SPECIES COMPARED TO COMMERCIAL CATCH AND 2020 ACLS

Species	Average Catch 2008-2012 (tons)			2015 Catch (tons)			2020 ACL[2] (tons)	2015 Research Catch Percent of 2020 ACL
	NEFSC and Cooperative Research	Commercial and Recreational	Research Catch Percent of Total	NEFSC and Cooperative Research	Commercial and Recreational	Research Catch Percent of Total		
Alewife	2.35	830	0.28%	3.19	0.43	88%	None[3]	NA
Atlantic cod (GBK stock)	5.40	10,854	0.05%	1.16	1,817	0.28%	2,346	0.05%
Atlantic cod (GOM stock)	ND[4]	ND	NA[5]	3.84	ND	NA	734	0.52%
Atlantic halibut	0.40	34	1.16%	0.41	175	0.23%	110	0.37%
Atlantic herring	13.30	89,755	0.01%	5.58	88,041	0.01%	None	NA
Atlantic mackerel	2.50	15,916	0.02%	4.62	6,270	0.07%	None	NA
Atlantic wolffish	0.31	31	0.98%	0.07	21	0.33%	93	0.08%

Species	Average Catch 2008-2012 (tons)			2015 Catch (tons)			2020 ACL[2] (tons)	2015 Research Catch Percent of 2020 ACL
	NEFSC and Cooperative Research	Commercial and Recreational	Research Catch Percent of Total	NEFSC and Cooperative Research	Commercial and Recreational	Research Catch Percent of Total		
Ocean pout	0.85	2	23.29%	0.57	103	0.55%	132	0.43%
Red hake (Southern Stock)	6.20	667	0.92%	1.04	2,178	0.40%	None	NA
Red hake (Northern stock)	ND	ND	NA	7.77	ND	NA	None	NA
Striped bass	4.20	16,084	0.03%	0.13	2,514	0.01%	None	NA
Thorny skate	0.65	0	100%	1.78	312	0.57%	None	NA
Weakfish	7.75	277	2.73%	8.79	78	11.28%	None	NA
Windowpane flounder (Southern stock)	1.70	74	2.24%	0.81	855	0.55%	504	0.16%
Windowpane flounder (Northern stock)	ND	ND	NA	3.91	ND	NA	95	4.12%
Winter flounder (SNE/MA stock)	6.50	2,389	0.27%	1.00	2,114	0.27%	772	0.13%
Winter flounder (GBK stock)	ND	ND	NA	1.67	ND	NA	866	0.19%
Winter flounder (CCB/GOM stock)	ND	ND	NA	3.07	ND	NA	472	0.65%
Witch flounder (grey sole)	0.75	986	0.08%	17.00	642	2.65%	1,045	1.63%
Yellowtail flounder (SNE/MA stock)	4.40	1,767	0.25%	0.17	1,467	0.21%	73	1.42%
Yellowtail flounder (GBK stock)	ND	ND	NA	1.04	ND	ND	180	0.58%
Yellowtail flounder (CCB/GOM stock)	ND	ND	NA	1.92	ND	ND	540	0.36%

[1] Not necessarily representative of research catch effects since while the research catch remained consistent at 3 tons, the commercial catch fell drastically from 650 to 0.5 tons.

Mortality from Surveys

The impact of mortality from fisheries research depends on the magnitude of the research catch relative to the overall biomass or population level of the species. Measuring these relative effects is difficult because there are many species for which total biomass estimates have fairly large confidence intervals so comparisons would also have a large range of relative magnitude. NMFS (2016b) assessed the magnitude of mortality by comparing the amount of fish caught in NEFSC research to the amount caught in commercial fisheries and the estimated catch from recreational fisheries (estimates are only available for the most popularly harvested species). Estimated discard data were included as part of the total mortality. Unfortunately, estimates of discard mortality were only available for 2015. Recreational estimated discards were not available at the time of this analysis. Thus, the 2015 section of this table has a more comprehensive comparison between research catch and commercial landings and discards added with recreational landings. This comparison indicated that for most species the average amount of fish killed in NEFSC-affiliated research was less than one percent of commercial and recreational landings.

However, since the 2016 analysis, it was recognized that comparing an estimate of research removal by stock to the estimate of stock abundance or ACL by stock, rather than to the entire population or species abundance in the NE LME, might be a more appropriate comparison to assess potential interference with the rebuilding of fish stocks especially of overfished stocks. The management problem was that it could not be determined whether NEFSC-affiliated research catch could be contributing to the potential decline of certain depressed fish stocks if the impact analysis was conducted at the species level rather than at the stock level. There was concern that certain stocks with low ACLs may not be able to absorb the additional catch associated with research resulting in an overage of the total ACL. Therefore, Table 4-9 presents NEFSC research catch data for species brought forward for analysis compared to the commercial and recreational catch, estimated discards for commercial catch for 2015, as well as the 2020 ACLs[8]. As previously stated, Appendix B provides the catch information for all 92 species analyzed in the 2016 PEA, regardless of current status.

As shown in Table 4-9, for species with ACLs research catch is a very small percentage of the ACL. In all cases except one (yellowtail flounder- SNE/MA stock) the research catch is less than 1% of the ACL. For these species, the impact of removals from NEFSC research activities would be considered minor adverse because it occurs but would not be expected to significantly affect future abundance. For species without an ACL, the 2015 research catch was generally less than 1% of the total catch (research and commercial catch combined). While the research catch of alewife has remained steady at around 3 tons, the commercial and recreational catch of alewife was around 650 tons in 2015 and 2016 but fell to less than 0.5 ton in 2017 (see Appendix B). Therefore, the high percentage shown in Table 4-9 is not necessarily representative of impacts.

Table 4-9 indicates that while mortality to fish species is a direct effect of the NEFSC surveys and cooperative research projects, there are likely no measurable effects occurring as a result of these research activities because the research catch represents such a small percentage of the ACL for each species by stock. For all target species in the Northeast region, mortality from NEFSC research activities would be

[8] 84 FR 34799

dispersed over a wide geographic area and considered minor adverse for all target species under the Status Quo/No Action Alternative.

Disturbance and Changes in Behavior due to Sound Sources

Generally, most acoustic sources used in NEFSC and NEFSC-affiliated research vessels are inaudible to fishes or pose no hearing threat. As described for ESA-listed fish (Section 4.3.2.1.1), disturbance and changes in fish behavior are expected to be short-term and not result in biologically significant changes to fish populations. Therefore, acoustic disturbance from NEFSC research is expected to have no effect on fish behavior.

4.3.2.1.3 Highly Migratory Species

Table 4-10 summarizes the potential impacts of the Status Quo/No Action alternative on HMS species brought forward from Section 3.2.1.3 (Table 3-5).

TABLE 4-10. SUMMARY OF POTENTIAL IMPACTS OF THE STATUS QUO/NO ACTION ALTERNATIVE ON HMS

HMS	Potential Impact of Status/Quo/No Action Alternative		Description
	Mortality from Surveys	**Disturbance Due to Sound Sources**	
Sharks			
Dusky	Moderate *adverse*	No effect	The population is overfished and NMFS estimates 100 years to rebuild by 2107 (NMFS 2020a). In 2018 the Apex Predator Bottom Longline Coastal Shark survey caught 309 dusky sharks, 52 of which suffered mortality (Table 4-11). This is one of the few fishery-independent surveys used to assess this population and an HMS Exempted Fishing Permit is obtained for each survey. Because the dusky shark population will take so long to rebuild, mortality from surveys is determined to be moderate adverse.
Blacknose	Minor *adverse*	No effect	NEFSC surveys over the period 2017-2018 captured a total of 303 blacknose sharks, of which only 12 suffered mortality (Table 4-11). In both 2017 and 2018 the commercial quota was 17.2 mt dw, of which only 45 and 30 percent were used, respectively, per year. Therefore, mortality of fewer than 20 sharks over a two-year period is considered a minor adverse effect.
Shortfin mako	No effect	No effect	Not typically encountered during NEFSC surveys; none were caught in 2017 and 2018 surveys (Table 4-11).
Oceanic whitetip	No effect	No effect	Listed as threatened under the ESA January 30, 2018 (80 FR 4153). Not typically encountered during NEFSC surveys; none were caught in 2017 and 2018 surveys (Table 4-11).

HMS	Potential Impact of Status/Quo/No Action Alternative		Description
	Mortality from Surveys	**Disturbance Due to Sound Sources**	
Scalloped hammerhead	Minor *adverse*	No effect	NEFSC surveys over the period 2017-2018 captured a total of 303 scalloped hammerhead sharks, over 1/3 of which (130) suffered mortality (Table 4-11). In both 2017 and 2018 the commercial quota for hammerheads was 27.1 mt dw, of which only 34 and 46 percent were used, respectively, per year. Therefore, mortality of 130 sharks totaling less than 0.2 mt ww over a two-year period would be a minor adverse effect.
Porbeagle	No effect	No effect	Not typically encountered during NEFSC surveys; none were caught in 2017 and 2018 surveys (Table 4-11).
Sandbar	Minor *adverse*	No effect	NEFSC surveys over the period 2017-2018 captured a total of 4,347 sandbar sharks, of which only 24 suffered mortality (Table 4-11). The biomass target for rebuilding is over 680,000 sharks so mortality of fewer than 25 over a two-year period is considered a minor adverse effect.
Tunas			
Bigeye	No effect	No effect	Not typically caught by NEFSC shark and COASTSPAN surveys.
Other Species			
Blue marlin	No effect	No effect	Not typically caught by NEFSC shark and COASTSPAN surveys.
White marlin	No effect	No effect	Not typically caught by NEFSC shark and COASTSPAN surveys.

Mortality from HMS Surveys

The following longline surveys have the potential to cause M/SI to HMS:

- Apex Predators Bottom Longline Coastal Shark Survey
- Apex Predators Pelagic Nursery Grounds Shark Study
- COASTSPAN Surveys.

Table 4-11 shows the number of overfished HMS sharks caught during the 2018 Apex Predators Bottom Longline Coastal Shark Survey and the 2017-2018 COASTPAN surveys. The Apex Predators Pelagic Nursery Grounds Shark Survey was not conducted over the period 2017-2019 and no future nursery grounds surveys are planned. NEFSC-affiliated research surveys for HMS are focused on sharks and do not typically involve the capture of other HMS such as tunas and marlin.

TABLE 4-11. OVERFISHED HMS SHARKS CAUGHT DURING NEFSC LONGLINE SURVEYS

Species	BMSY[3] (mt or # of sharks)	2018 Apex Predators Bottom Longline Coastal Shark Survey[1,2]			2017-2018 COASTSPAN Surveys[1]		
		Total Caught	Tagged	Mortality	Total Caught	Tagged	Mortality
Dusky[4]	Unknown	309	197	52	0	0	0
Blacknose[5]	77,577 - 288,360 sharks	8	3	5	295	272	7
Shortfin mako[6]		0	0	0	0	0	0
Oceanic whitetip[7]	Unknown	0	0	0	0	0	0
Scalloped hammerhead[8]	62,000 sharks	104	84	16	284	15	130
Porbeagle[9]	29,382 -40,676 mt	0	0	0	0	0	0
Sandbar[10]	681,000 sharks	1529	1463	16	2818	2644	8

1 Source: Personal communication C. McCandless NOAA NMFS Narragansett Lab and NMFS (2019)
2 This survey was not conducted in 2019 but is planned for 2021.
3 Stock biomass needed for maximum sustainable yield in mt or numbers of sharks as indicated. Source (ASMFC 2019a).
4 Rebuilding estimated to take 100 years ending 2107 (NMFS 2020a)
5 Rebuilding estimated to take 30 years ending 2043 (NMFS 2020a)
6 Rebuilding plan will be established by ICCAT (84 FR 5358).
7 See Section 3.2.1.3.
8 Rebuilding estimated to take 10 years ending 2023 (NMFS 2020a)
9 Rebuilding estimated to take 100 years ending 2108 (NMFS 2020a)
10 Rebuilding estimated to take 66 years ending 2070 (NMFS 2020a)

Many of the sharks caught during NEFSC research surveys were captured alive, measured, tagged, and released alive (Table 4-11). NEFSC and cooperative research surveys will continue to catch HMS sharks intentionally and incidental to surveys targeting other species, but mortality will likely be low, infrequent, and distributed over a wide geographic area; the effects of mortality on HMS shark species from NEFSC fisheries research under the Status Quo Alternative would be considered minor adverse for all species but the dusky shark. For this prohibited species, the effects would be moderate adverse due to the high numbers suffering M/SI relative to the survey catch and the long estimated time period required to rebuild the dusky stock.

Disturbance and Changes in Behavior Due to Sound Sources

As described for ESA-listed fish, overall, disturbance and changes in fish behavior are expected to be short-term and not result in biologically significant changes to fish populations given most acoustic sources are inaudible to fish species (see Section 4.3.2.1.1). Therefore, NEFSC research is expected to have no effect on HMS behavior.

Summary of Effects on Fish

Mortality due to research surveys for most species targeted by commercial fisheries is much less than one percent of commercial and recreational harvest and is considered to have minor adverse effects for all species under Status Quo (Alternative 1). Witch flounder, yellowtail flounder, and alewife are the only species for which research catch exceeds one percent of commercial catch (including discards). For the two flounder species research catch is still very small relative to the population of each species. For alewife the percentage of research catch related to commercial catch is high because the commercial catch drastically dropped from 650 to 0.5. Previous to 2015 the percentage of research catch was less than 0.5% (see Appendix B). Research catch of highly migratory species (Table 4-11) is also very small and considered to have minor adverse effects on the populations of HMS species. Disturbance due to the use of acoustic devices during NEFSC research is not expected to have adverse effects on target or HMS fish species.

4.3.2.2 Effects on Marine Mammals

As described in Section 3.2.2 and Table 3-7, a number of ESA-listed and non-listed cetaceans in the NE LME have had changes to status or abundance and have been brought forward for reanalysis in this SPEA. In addition, incidental takes due to disturbance have been documented during NEFSC research activities for species in the LME and offshore areas. Table 4-12 summarizes the potential effects of the Status Quo/No Action Alternative on ESA-listed and non-listed marine mammals.

4.3.2.2.1 Mortality from Surveys

During 2017 and 2018 research surveys, the NEFSC reported no Level A interactions with marine mammals (see Annual Report under Section 7(a)(2) of the ESA and 101(a)(5)(A) of the MMPA for Fisheries and Ecosystem Research Activities Conducted by Northeast Fisheries Science Center for the periods September 09, 2016–December 31, 2017 and January 01, 2018–December 31, 2018). On September 24, 2019, a lethal take of a common dolphin occurred during a Cooperative Research cruise sponsored by the NEFSC. The gear was a 4 seam 3 bridle Bigelow net with a spread restrictor cable. This is the only marine mammal M/SI take during the 2017, 2018 and 2019 survey seasons. Considering the 2016 rule (81 FR 3061) authorized 8 takes each from the coastal migratory and offshore common dolphin stocks over the 5-year period, the effect of this one mortality is considered minor adverse.

4.3.2.2.2 Disturbance and Change in Behavior Due to Sound Sources

Tables 4-13 and 4-14 show the actual Level B harassment takes for species in the NE LME and offshore areas from September 2016 to December 2018 as compared to the authorized numbers (81 FR 53061).

With the exception of one pinniped species recorded takes over the period 2015-2018 are all either zero or well below authorized levels. For species where takes below the allowed limit have occurred the effect is considered to be minor adverse (see Table 4-12).

TABLE 4-12. SUMMARY OF POTENTIAL IMPACTS OF THE STATUS QUO/NO ACTION ALTERNATIVE ON NE LME AND OFFSHORE ESA-LISTED AND NON-LISTED MARINE MAMMALS

Marine Mammals	Potential Impact of Status/Quo/No Action Alternative			Discussion
	Injury or Mortality	Changes in Food Availability	Disturbance from Sound Sources	
ESA-Listed				
North Atlantic right whale	No effect	No effect	No effect	The population of this stock has not changed over the 2015-2018 period and remains below 100 individuals. The 2016 rule adjusted the take estimates from ten to zero because of the low probability of sighting or interaction with these species during most research cruises with the active acoustic instruments used in NEFSC research[1]. Disturbance takes are not expected and have not been documented.
Sperm Whale	No effect	No effect	Minor *Adverse*	Disturbance takes have not been documented in the LME over 2016-2019[2], but one take been documented for offshore areas in 2017 and 2018 (Table 4-14). The 2016 rule adjusted the take estimates from ten to zero for the LME area but allows 15 disturbance takes for offshore area[1].
Fin Whale	No effect	No effect	No effect	Abundance estimates have decreased since 2016. The 2016 rule adjusted the take estimates from ten to zero. Disturbance takes are not expected and have not been documented in the LME or offshore[2].
Non-Listed LME Area Species				
Atlantic white-sided dolphin	No effect	No effect	Minor *Adverse*	No change in status or abundance estimates since 2016. Disturbance takes occur but are well below authorized levels (Table 4-13).
Common bottlenose dolphin (coastal)	Minor *Adverse*	No effect	Minor *Adverse*	Migratory coastal stock abundance estimates have decreased since 2016. One M/SI take (lethal) occurred in 2019 during a Cooperative Research cruise. Eight Level A takes are allowed over the 5-year period[1]. Disturbance takes occur but are well below authorized levels (Table 4-13).
Common bottlenose dolphin (offshore)	Minor *Adverse*	No effect	Minor *Adverse*	No change in status or abundance since 2016. Disturbance takes occur but are below authorized levels (Table 4-13).

Marine Mammals	Potential Impact of Status/Quo/No Action Alternative			Discussion
	Injury or Mortality	Changes in Food Availability	Disturbance from Sound Sources	
Cuvier's beaked whale	No effect	No effect	Minor *Adverse*	No change in status or abundance estimates since 2016. Disturbance takes occur but are below authorized levels (Table 4-13).
Dwarf/Pygmy sperm whale	No effect	No effect	Minor *Adverse*	No change in status since 2016, but abundance has increased. Disturbance takes occur but are below authorized levels (Table 4-13).
Harbor Porpoise	No effect	No effect	Minor *Adverse*	No change in status or abundance estimates since 2016. Disturbance takes occur but are well below authorized levels (Table 4-13).
Humpback Whale GOM DPS	No effect	No effect	No effect	The West Indies DPS of which the GOM stock of humpback whale is included was delisted (81 FR 62259). The 2016 rule adjusted the take estimates from ten to zero[1]. Disturbance takes are not expected and have not been documented in the LME or offshore[2].
Long-finned Pilot Whale	No effect	No effect	Minor *Adverse*	Abundance estimates have decreased since 2016. Disturbance takes occur but are well below authorized levels (Table 4-13).
Mesoplodon beaked whales	No effect	No effect	Minor *Adverse*	No change in status or abundance estimates since 2016. Disturbance takes occur but are below authorized levels (Table 4-13).
Minke whale	No effect	No effect	No effect	Abundance estimates have decreased since 2016. The 2016 rule adjusted the take estimates from ten to zero[1]. Disturbance takes have not been documented in the LME[2].
Risso's dolphin	No effect	No effect	Minor *Adverse*	No change in status or abundance estimates since 2016. Disturbance takes occur but are below authorized levels (Table 4-13).
Short-beaked common dolphin	No effect	No effect	Minor *Adverse*	Abundance estimates have decreased since 2016. Disturbance takes occur but are well below authorized levels (Table 4-13).
Short-finned Pilot Whale	No effect	No effect	Minor *Adverse*	No change in status or abundance estimates since 2016. Disturbance takes occur but are below authorized levels (Table 4-13).
White-beaked dolphin	No effect	No effect	Minor *Adverse*	No change in status or abundance estimates since 2016. Disturbance takes occur but are below authorized levels (Table 4-13).

Marine Mammals	Potential Impact of Status/Quo/No Action Alternative			Discussion
	Injury or Mortality	Changes in Food Availability	Disturbance from Sound Sources	
Gray Seal	No effect	No effect	Minor *Adverse*	Abundance estimates have decreased since 2016. The 2016 rule adjusted the take estimates from ten to zero. Disturbance takes are not expected and have not been documented in the LME or offshore[2]. Disturbance also occurs during the Penobscot Bay pinniped haulout survey (Table 4-15).
Harbor Seal	No effect	No effect	Minor *Adverse*	No change in status or abundance estimates since 2016. Disturbance takes occur but are below authorized levels (Table 4-13). Disturbance also occurs during the Penobscot Bay pinniped haulout survey (Table 4-15).
Non-Listed Offshore Area Species				
Atlantic spotted dolphin	No effect	No effect	Minor *Adverse*	No change in status or abundance estimates since 2016. Disturbance takes occur but are below authorized levels (Table 4-14).
Common bottlenose dolphin (offshore)	No effect	No effect	Minor *Adverse*	No change in status or abundance since 2016. Disturbance takes occur but are well below authorized levels (Table 4-14).
Cuvier's beaked whale	No effect	No effect	Minor *Adverse*	No change in status or abundance estimates since 2016. Disturbance takes occur but are below authorized levels (Table 4-14).
Dwarf sperm whale	No effect	No effect	No effect	No change in status but abundance estimates have increased since 2016. No disturbance takes occurred in 2017-2019 (Table 4-14).
Long-finned pilot whale	No effect	No effect	Minor *Adverse*	Abundance estimates have decreased since 2016. Disturbance takes occur but are well below authorized levels (Table 4-14).
Mesoplodon beaked whales	No effect	No effect	Minor *Adverse*	No change in status or abundance estimates since 2016. Disturbance takes occur but are below authorized levels (Table 4-14).
Minke whale	No effect	No effect	No effect	Abundance estimates have decreased since 2016. The 2016 rule adjusted the take estimates from ten to zero[1]. Disturbance takes are not expected have not been documented in the offshore area[2].

Marine Mammals	Potential Impact of Status/Quo/No Action Alternative			Discussion
	Injury or Mortality	Changes in Food Availability	Disturbance from Sound Sources	
Northern bottlenose whale	No effect	No effect	No effect	Abundance estimates are unknown. No disturbance takes occurred in 2017-2019 (Table 4-14).
Pygmy sperm whale	No effect	No effect	No effect	No change in status or abundance estimates since 2016. No disturbance takes occurred in 2017-2019 (Table 4-14).
Risso's dolphin	No effect	No effect	Minor *Adverse*	No change in status or abundance estimates since 2016. Disturbance takes occur but are below authorized levels (Table 4-14).
Rough toothed dolphin	No effect	No effect	Minor *Adverse*	No change in status or abundance estimates since 2016. Disturbance takes occur but are below authorized levels (Table 4-14).
Short-beaked common dolphin	No effect	No effect	Minor *Adverse*	Abundance estimates have decreased since 2016. Disturbance takes occur but are well below authorized levels (Table 4-14).
Short-finned pilot whale	No effect	No effect	Minor *Adverse*	No change in status or abundance estimates since 2016. Disturbance takes occur but are well below authorized levels (Table 4-14).
Striped dolphin	No effect	No effect	Minor *Adverse*	No change in status or abundance estimates since 2016. Disturbance takes occur but are well below authorized levels (Table 4-14).

[1] 81 FR 53061
[2] (NEFSC 2018c, 2019b, 2020)

TABLE 4-13 TOTAL ANNUAL LEVEL B HARASSMENT TAKES BY ACOUSTIC SOURCES FOR LME MARINE MAMMALS, 2016-2018

Species[1]	2016 -2021 Authorized Annual Level B Take[1]	Sep. 9, 2016– Dec. 31, 2017[2]	Jan. 1– Dec. 31, 2018[3]	Jan. 1– Dec. 31, 2019[4]
Cetaceans				
Atlantic white-sided dolphin	144	87	70	113
Common bottlenose dolphin (coastal)	609	368	297	477
Common bottlenose dolphin (offshore)	35	21	17	28
Cuvier's beaked whale	13	7	6	9
Dwarf/Pygmy Sperm Whale[5]	0	0	0	0
Harbor Porpoise	113	69	55	89
Long-finned Pilot Whale	203	123	99	159
Mesoplodon beaked whales	13	7	6	10
Risso's dolphin	13	8	6	10
Short-beaked common dolphin	1247	754	608	977
Short-finned Pilot Whale	203	123	99	159
Sperm Whale	0	0	0	0
White-beaked dolphin	48	29	23	37
Pinnipeds				
Gray seal	0	0[6]	0	0
Harbor seal	1678	1013	817	1,313

[1] 81 FR 53061
[2] NEFSC (2018c)
[3] NEFSC (2019b)
[4] (NEFSC 2020)
[5] For species with unknown or very low volumetric densities, NMFS adjusted the take estimates from ten to zero because of the low probability of sighting or interaction with these species during most research cruises with the active acoustic instruments used in NEFSC research.
[6] The 2017 annual report showed 101 gray seal acoustic takes. This number has been determined to be an error and takes were actually zero (personal communication NEFSC Jan. 22, 2020).

TABLE 4-14. TOTAL ANNUAL LEVEL B HARASSMENT TAKES BY ACOUSTIC SOURCES FOR OFFSHORE MARINE MAMMALS, 2016-2019

Species[1]	2015 -2020 Authorized Annual Level B Take[1]	Sep. 9, 2016– Dec. 31, 2017[2]	Jan. 1– Dec. 31, 2018[3]	Jan. 1– Dec. 31, 2019[4]
Cetaceans				
Atlantic spotted dolphin	16	3	2	0
Common bottlenose dolphin (offshore)	41	7	5	0
Cuvier's beaked whale	20	1	1	0
Dwarf Sperm Whale	2	0	0	0
Long-finned Pilot Whale	32	1	1	0
Mesoplodon beaked whales	20	1	1	0
Northern Bottlenose whale	2	0	0	0
Pygmy sperm whale	2	0	0	0
Risso's dolphin	66	11	8	0
Rough toothed dolphin	1	0	0	0
Short-beaked common dolphin	146	25	17	0
Short-finned pilot whale	32	1	1	0
Sperm whale	15	1	1	0
Striped dolphin	236	41	27	0

[1] 81 FR 53061
[2] NEFSC (2018c)
[3] NEFSC (2019b)
[4] NEFSC (2020)

Level B Disturbance of Penobscot Bay Pinniped Haul-out Area Survey

As part of the NEFSC Atlantic Salmon Group's Penobscot hydro-acoustic transect survey, Avian and Marine Mammal Census (referred as Penobscot River pinniped haul out census in LOA) are conducted to document fish predators relative to the fish biomass identified in the acoustics. NEFSC Atlantic Salmon Research Team used 10x50 magnification binoculars to survey both sides of the river and ahead of the boat for birds and mammals, continually scanning as the boat proceeded along the transect line. All bird and marine mammal species in or immediately above the river or using the banks of the river, and their primary (*i.e.* swimming, flying, and stationary) and secondary (i.e. foraging, resting) behavior were recorded. Time of each observation was recorded to the nearest minute. The observations and time were joined with the waypoint data from the global positioning system (GPS) to geospatially assign observations. The width of the estuary allowed for accurate observation from shore to shore for the northern estuary portion but wider sections in the lower estuary were considered a sample count and not a census. The speed of the boat allowed for approximately 200 m to be traveled in one minute, and most birds and marine mammals were observed well within 200 m. Effort was made to avoid counting birds multiple times in the same area by tracking activity as much as practical. The transect design passes by

3 ledges that are potential pinniped haul-outs and these points are observed by binoculars from a distance of 300-500 m.

The NEFSC ranks hauled-out pinniped behavior according to the three-point scale of response severity (1 = alert; 2 = movement; 3 = flight). In general, the haul-out seals remained on the ledge during observation and did not flight to the water as a group. According to the three-point scale of response severity (1 = alert; 2 = movement; 3 = flight), the haul-out observations should be considered level = 1 as it isn't possible to equate movement and flight from the ledge as caused by the vessel or acoustic gear versus normal behaviors. During the 13 hydroacoustics surveys in 2017, 3 species of marine mammal were observed: Harbor seal *Phoca vitulina*, gray seal *Halichoerus grypus* and harbor porpoise *Phocoena phocoena*. Table 4-15 shows the number of pinniped hauled out and their response severity score during surveys conducted in 2017 and 2018. The mammals observed never maintained their position and either swam away or dove assumingly in response to the nearby vessel.

Table 4-15. Pinniped Haul Out Survey and Response Severity

Species	2017[1]			2018[2]			2019[3]		
	Count (on haul-out)	Count (in water)	Response (severity score = # of animals)	Count (on haul-out)	Count (in water)	Response (severity score = # of animals)	Count (on haul-out)	Count (in water)	Response (severity score = # of animals)
Harbor seal	242	65	(1) (3)	401	52	(1) (3)	330	50	(1) (3)
Gray seal	2	17	(1) (3)	0	11	(1) (3)	33	29	(1) (3)
Harbor porpoise	n/a	1	(1) (3)	n/a	2	(1) (3)	n/a	0	(1) (3)

[1] NEFSC (2018c)
[2] NEFSC (2019b)
[3] NEFSC (2020)

4.3.2.2.3 Changes in Food Availability Due to Research Survey Removal of Prey and Discards

The 2016 PEA analyzed the potential impacts of prey removals on marine mammal species and determined that the total amount of these species taken in research surveys is very small relative to their overall biomass in the area.

While many NEFSC research cruises sample zooplankton on which Atlantic right whales, sei whales, and blue whales feed, the biomass of plankton collected is negligible and would have no effect on prey availability for these whales. There is some overlap in prey of humpback and fin whales (e.g., Atlantic herring) and, possibly, sperm whales (squid) with species taken during fisheries research. The total prey removal by all NEFSC fisheries research surveys and projects, regardless of season and location across the NE LME, totals a few hundreds of tons of fish per year (see Table 4-16), which is a negligible percentage of the estimated fish consumed by cetaceans. Only typical high quality prey items are shown in Table 4-16. The NEFSC research catch of invertebrate prey is also small; the average annual NEFSC research catch of long-finned squid was less than 12 tons (see Section 4.3.1.2.3).

TABLE 4-16. PREY BIOMASS REMOVED DURING NEFSC RESEARCH SURVEYS

Prey Species	Estimated Stock Biomass (tons)	2020 Allowable Biological Catch (ABC) (tons)	Research Catch 2017 (tons)	Commercial Catch 2017 (tons)
Atlantic herring	571,000[1]	17,781[2]	8	54,000
Atlantic mackerel	unknown	32,170[3]	8	11,700
Longfin Squid	unknown	25,794[2]	4	9,000
Northern shortfin squid	unknown[4]	26,000[4,5]	0.6	25,000
Northern shrimp	3,525[6]	NA	0.5	32.6

[1] NEFSC (2018b)
[2] NEFMC (2018)
[3] http://www.mafmc.org/newsfeed/2019/noaa-fisheries-proposes-atlantic-mackerel-squid-and-butterfish-quotas-for-the-2020-fishing-year
[4] Macho and Humberstone (2019)
[5] 2020 ABC as suggested by Macho and Humberstone (2019)
[6] Hunter *et al.* (2018)

In addition to the small total biomass taken, research surveys tend to target smaller size classes of fish than are preferred by marine mammals. Research catches are also distributed over a wide area because of the random sampling design covering large sample areas. Fish removals by research are therefore highly localized and unlikely to affect the spatial concentrations and availability of prey for any marine mammal species. This is especially true for pinnipeds in the Atlantic, which are opportunistic predators that consume a wide assortment of fish and squid.

Therefore, NEFSC fisheries research catch levels are very small relative to the estimated consumption of prey by marine mammals, dispersed over large areas and time periods, and are unlikely to affect changes in prey type or quantity available to any marine mammals. The overall effect of research catches on marine mammals through competition for prey is therefore considered minor adverse for all species.

NEFSC fisheries research catch levels for prey species are very small relative to the stock biomass (where available) and 2017 commercial catch as shown in Table 4-16. In addition, the estimated consumption of prey by marine mammals, dispersed over large areas and time periods, is unlikely to affect changes in prey type or quantity available to any marine mammals. The overall effect of research catch on marine mammals through competition for prey is therefore considered minor adverse for all species in the NEFSC research area.

4.3.2.2.4 Potential Effects on Designated Critical Habitat for Marine Mammals

Designated critical habitat for North Atlantic right whales overlaps with NEFSC survey activities. However the proposed action is not likely to affect the physical or biological features that comprise the critical habitat. The Northeastern U.S. foraging habitat, which is located within the Action Area, has been designated as critical habitat for right whales due to the presence of dense concentrations of copepods (NMFS 2016a). The gear types used in the proposed action will not affect the availability of copepods because they are very small crustaceans that will pass through the fishing gear rather than being captured in it and removed. In addition, the proposed actions will not affect the oceanographic conditions in the Gulf of Maine, which concentrate the copepods. Therefore, the proposed action will not destroy or adversely affect designated North Atlantic right whale critical habitat. Critical habitat has not been designated for sperm, blue, sei, or fin whales.

4.3.2.2.5 Summary of Effects on Marine Mammals

No mortality or serious injury takes have occurred during any past NEFSC research activities and incidental takes (Level B) for acoustic or other disturbance have been below levels authorized in the 2016 LOA (Tables 4-13 and 4-14). Considering these factors and that bridge crew watch for marine mammals during transits, vessels use slow cruising speeds, and because the number of research cruises is low, ship strikes with marine mammals during NEFSC research activities would be unlikely to occur in the future. Relative to the amount estimated to be consumed by marine mammals, research surveys remove small amounts of fish, invertebrates, and plankton distributed over a broad research area. The brief NEFSC sampling efforts are unlikely to affect the prey availability or foraging success of any marine mammals. Therefore, adverse impacts on marine mammals are considered minor under the Status Quo.

4.3.2.3 Effects on Sea Turtles

Table 4-17 summarizes the potential effects of the Status Quo/No Action Alternative on sea turtles.

TABLE 4-17. SUMMARY OF POTENTIAL IMPACTS OF STATUS QUO/NO ACTION ALTERNATIVE ON MARINE TURTLES

Turtle Species	Potential Impact of Status/Quo/No Action Alternative		Description
	Mortality from Surveys	Disturbance Due to Sound Sources	
Kemp's Ridley	Minor *Adverse*	No effect	Lethal and non-lethal takes are allowed; eighteen Kemp’s ridley turtles taken over 2017 to 2019 were released alive and uninjured.
Loggerhead	Minor *Adverse*	No effect	Lethal and non-lethal takes are allowed; seventeen loggerhead turtles taken over 2017 to 2019 were released alive and uninjured.
Green	Minor *Adverse*	No effect	No lethal takes are allowed. Six green turtles captured over 2017 to 2019 were released alive and uninjured.
Leatherback	No effect	No effect	Lethal and non-lethal takes of leatherback turtles are allowed, but none occurred from 2017 - 2019.

4.3.2.3.1 Mortality from Surveys

As stated in the annual reports for incidental take, over the five year period, NEFSC is authorized to capture: 85 NWA DPS loggerhead sea turtles (ten lethal); 95 Kemp's Ridley sea turtles (15 lethal); 10 North Atlantic DPS green sea turtles (none lethal); and 10 Leatherback sea turtles (five lethal).

Table 4-18 shows the actual number of incidental turtle takes from 2017 to 2019, which are well below the authorized levels, and no lethal takes occurred over the period. There were 15, 17 and 9 turtles taken, respectively, from all of NEFSC projects in 2017, 2018, and 2019. In 2018, three green turtles were caught in COASTSPAN small set gillnets by Florida Atlantic University; in 2019 two turtles were caught in this survey. Each green turtle was released alive and in good condition before any measurements or tagging could occur. A combination of running out of tags and some the COASTSPAN projects having limited time and experience resulted in a reduction in the number of tags applied and samples taken. NEFSC will work with the COASTSPAN project to improve the tagging and sampling moving forward. Because takes have occurred but all turtles were released alive and uninjured, the impacts of the Status Quo alternative would be minor adverse.

TABLE 4-18. INCIDENTAL TURTLE TAKES IN NEFSC RESEARCH SURVEYS, 2017 AND 2018

Species	2017[1]			2018[2]			2019[3]
	Total	Tagged	Biopsy Taken	Total	Tagged	Biopsy Taken	Total
Kemp's Ridley	8	2	4	4	3	4	6
Loggerhead	6	2	3	10	9	9	1
Green	1	0	0	3	0	0	2
Total	**15**	**4**	**7**	**17**	**12**	**13**	**9**

Note: All turtles were released alive.
[1] NEFSC (2018b).
[2] NEFSC (2019b).
[3] NEFSC (2020).The this annual reported noted that the two green turtles were released before tagged. No other information on tagging or biopsies of turtles was provided.

4.3.2.3.2 Disturbance Due to Sound

Little is known about hearing in sea turtles, but the available information suggests that their underwater hearing capabilities are quite limited both in functional hearing bandwidth and in absolute hearing sensitivity. Turtles have been shown to respond to low frequency sound. Data suggest that sea turtle hearing is functionally sensitive between about 100 Hz and 1.2 kHz (Ketten and Bartol 2006, Dow Piniak *et al.* 2012), which is well below the frequencies of acoustic instruments used in fisheries research (18-133kHz). The higher frequency sounds are unlikely to be audible to sea turtles and therefore unlikely to have adverse effects.

4.3.2.3.3 Potential Effects on Designated Critical Habitat

Only the Northwest Atlantic DPS loggerhead sea turtle has designated critical habitat in the Action Area. Mechanical and physical actions associated with NEFSC research such as setting and hauling gear, and

research vessel movements are not expected to alter physical or biological features of the loggerhead critical habitat such that life history patterns of individual sea turtles or the health of sea turtle prey species would be affected. Therefore, the proposed action will not destroy or adversely modify loggerhead turtle designated critical habitat.

4.3.2.3.4 Summary of Effects on Sea Turtles

Compared to the number of incidental captures of sea turtles accounted for in the 2016 BiOp, the numbers of sea turtles actually taken in 2017, 2018, and 2019 are very low and none of the takes were lethal (Table 4-18). These low levels of take are anticipated to be similar under the Status Quo in future years and considering that most acoustic sources would be inaudible to sea turtles, the potential effects of research are expected to be minor.

4.3.2.4 Effects on Invertebrates

Table 4-19 summarizes the potential impacts of the Status Quo alternative on invertebrate species brought forward for analysis (see Table 3-10).

TABLE 4-19. SUMMARY OF POTENTIAL IMPACTS OF THE STATUS QUO/NO ACTION ALTERNATIVE ON INVERTEBRATES

Invertebrate Species	Mortality from Surveys	Description
American lobster	Minor *adverse*	Research catch was only 0.03% of the total catch in 2017 (Table 4-20).
Northern shrimp	Moderate *adverse*	Spawning stock biomass in 2017 was estimated at 782 tons, well below the time series mean of 3,828 tons. NEFSC and cooperative research caught 0.5 tons of northern shrimp in 2017 (Table 4-20).
Horseshoe crab	Minor *adverse*	Research catch was only 0.05% of the total catch in 2017 (Table 4-20).

4.3.2.4.1 Mortality from Surveys

Direct mortality of invertebrates occurs as a result of fisheries research surveys. Table 4-20 presents NEFSC research catch data for the three invertebrate species for 2017 brought forward for analysis, compared to the commercial and recreational catch of these species.

As shown in Table 4-20, for American lobster and horseshoe crabs, the research catch is a very small percentage of the total catch. As shown in Table 4-20, for northern shrimp the research catch in 2017 was about 2% of the total catch. While the 2017 research catch of about a half ton was much lower than the average catch over 2008-2012 (NMFS 2016b), the commercial catch has been greatly reduced due to moratorium on the GOM fishery in place since 2014 and continuing until 2021. Overall, NEFSC research removals would have no effect or a minor adverse effect on American lobster and horseshoe crab but could have moderate adverse effects on northern shrimp if the population continues to decline.

TABLE 4-20. RESEARCH CATCH OF INVERTEBRATES COMPARED TO COMMERCIAL CATCH

Species	Average Catch 2008-2012 (tons)			2017 Catch (tons)		
	NEFSC and Cooperative Research	Commercial and Recreational	Research Catch Percent of Total Catch[1]	NEFSC and Cooperative Research	Commercial and Recreational	Research Catch Percent of Total Catch[1]
American lobster	11	58,190	0.02%	18.41	66,721	0.03%
Northern shrimp	2.4	4,482	0.05%	0.53	28	1.9%
Horseshoe crab	3.8	754	0.5%	1.61	1,194	0.13%

4.3.2.4.2 Summary of Effects on Invertebrates

Research conducted by NEFSC contributes important information used in stock assessments for several invertebrate species (i.e., lobsters, scallops, Loligo and Illex squid, surfclams, and quahogs) that are important commercial and recreational resources. As shown in Table 4-20, the magnitude of mortality due to research sampling is small relative to commercial harvests. While NEFSC conducts research with bottom-contact gear in several areas closed to commercial fishing, much of this effort is conducted using video cameras and other low-impact technologies. Therefore, only minor adverse impacts to invertebrates are expected from NEFSC research activities and beneficial indirect effects from research can be attributed to the contribution of scientific information for sustainably managing invertebrate species.

4.3.3 Effects on Vegetation

As described in Section 3.3.6, Johnson's seagrass may be found in nearshore areas off the Florida coast where COASTSPAN surveys occasionally occur. Because the surveys are conducted using gillnets of longlines deployed from small boats or skiffs, and the gear is not dragged along the seafloor, the surveys may have a minor adverse effect on the species. NEFSC COASTSPAN surveys are not expected to affect designated Johnson's seagrass critical habitat.

4.3.4 Effects on the Social and Economic Environment

Major factors that could be influenced by the NEFSC research program include:

- Collection of scientific data used in sustainable fisheries management
- Economic support for fishing communities
- Collaborations between the fishing industry and fisheries research
- Fulfillment of legal obligations specified by laws and treaties.

Section 3.3 of this SPEA describes how NEFSC fisheries and ecosystem research activities may have direct and indirect effects on the economics of U.S. communities and ports in which they operate. NEFSC facilities are located in Massachusetts, Rhode Island, Connecticut, New Jersey, Washington DC, and

Maine. At sea assessments extend south across the Atlantic Seaboard. Cumulative effects to the communities in these regions are obviously complex and involve multiple factors that result in driving changes both socially and economically. For the purposes of assessing the effects of NEFSC research on socioeconomics in these areas, this SPEA relies on information from the commercial and recreational fisheries to provide a general sense of revenues and economic impact. NMFS's recent report titled *'The Fisheries Economics of the United States'* (NMFS 2018a) provides information on commercial market conditions, total tonnage of commercial fish landed and revenue by region and state, recreational fishing expenditures and levels of participation by region and state, key species, and community profiles which has been summarized in Section 3.3 of this SPEA.

Annual expenditures of the NEFSC for fisheries and ecosystem research have ranged from $60 - $70 million for the period 2016–2018. This funding is used to support field surveys, data collection and analysis, permitting, reporting and other administrative functions. Through direct expenditures on fisheries and ecosystem research, NEFSC contributes to the communities and ports across the Atlantic seaboard. While the contribution of research-related employment and purchased services is beneficial on an individual basis, the total contribution of research is very small when compared to the value of commercial and recreational fisheries in the communities. Fisheries research is considered a minor beneficial effect to the economic status of communities within the research areas.

4.3.4.1 Collection of Scientific Data Used in Sustainable Fisheries Management

Stock assessments in the Northeast research regions rely on the data collected from long-term standardized resource surveys conducted by NOAA fishery research vessels. Fishery managers use the extended time-series of data to identify trends and to inform fisheries management decision-making. This information is essential for establishing annual species-specific sustainable harvest limits. Harvest limits that are set too high may lead to overfishing of specific stocks and more restrictive management measures in the future to rebuild those stocks. Harvest limits that are set too low do not allow a maximum sustainable harvest that benefits commercial and recreational fisheries and the communities and services that support them. In addition, the predictability and reliability of long-term data sets and the harvest limits they support is essential for economic stability in the fisheries over time.

4.3.4.2 Economic Influence of Research

As described in Section 3.3.1, the NEFSC spends approximately $60–$70 million in annual operations costs. These funds provide both primary and secondary economic influences on the communities and ports in the region. These funds are distributed among NEFSC research stations within the NEFSC Action Area. The operating budget directly supports employees and operations of facilities at these locations. Approximately $60–$70 million is spent annually on collecting data at-sea over a geographic area extending from Canada to North Carolina. Funds are expended for ship and aircraft time, equipment and logistics, contracts, crew wages, and taxes and fees. NOAA-owned ships, charters, and leased research vessels operate from several home ports, and are serviced in many others. Some commercial fishing operations are compensated for participation in cooperative research projects through grants or shares in fishing quotas that they sell on the market.

4.3.4.3 Collaborations Between the Fishing Industry and Fisheries Management

Cooperative research is an important element in establishing communication, trust, and information exchanges between scientists, fisheries managers, and the fishing industry. Cooperative research is used to: a) increase the precision and expand the scope of resource surveys; b) provide supplemental information about fishing operations; c) incorporate fishing expertise into the design and implementation of research; and d) build mutual understanding and respect among scientists and people in the fishing industry. Collaboration in the development of new gear and techniques encourages participation in developing sustainable fishing practices and contributes to a broader understanding of management for marine resources.

4.3.4.4 Fulfillment of Obligations to Communities Specified by Laws and Treaties

A list of applicable laws is shown in Chapter 6 of the PEA (NMFS 2016b). These obligations include the 1996 amendment to the MSA, which requires assessment, specification, and description of the effects of conservation and management measures on participants in fisheries, and on fishing communities (NMFS 2007); and EO 12898 on environmental justice, which directs agencies to assess actions that may disproportionately affect low income and minority populations. The fisheries research programs conducted in the CCRA, ETPRA, and ARA help fulfill these obligations under the MSA.

4.3.4.5 Summary of Effects on the Social and Economic Environment

Both Status Quo and Alternative 2 (Preferred Alternative) would contribute important scientific information for sustainable fisheries management of the valuable commercial and recreational fisheries along the U.S. Atlantic Coast. These contributions benefit commercial and recreational fisheries and the communities that support them. The fishing industry generates billions of dollars' worth of sales, thousands of commercial fishing-related jobs, and provides millions of people across the country with highly valued seafood. Recreational fishers also participate and support fishing service industries (see Section 3.3). Direct employment, purchase of fuel, vessel charters, and supplies for NEFSC fisheries research would also result in minor benefits to fishing communities along the coast. NEFSC fisheries research also builds trust and encourages cooperation between the fishing industry and NMFS scientists and fisheries managers. For these reasons, the overall effects of NEFSC-affiliated research is considered to have long-term, minor to moderately beneficial effects on social and economic resources under both alternatives.

4.4 Direct and Indirect Effects of Alternative 2 - Increased Fisheries Research (Preferred Alternative)

As described in Chapter 2 and shown in Table 2-1, this alternative includes all of the studies described in Alternative 1 (Status Quo/No Action) plus the following additional activities:

- Bottom trawl: Community Structure; Marine Resources Survey; Herring Survey; Fish Collection; Flatfish Survey; Conservation Engineering Projects such as gearnet work and selectivity studies in small mesh fisheries and squid; Tagging Projects.
- Pelagic trawl: Deepwater Biodiversity Survey; Atlantic Herring Survey; Atlantic Salmon Survey; Catchability Surveys; NEFOP Mid-water Trawl Observer Training.

- Longline Surveys: Apex Predators Pelagic Longline Shark Survey; NEFOP Bottom Longline Observer Training.
- Dredge Surveys: Conservation Engineering Projects such as scallop dredge finfish and turtle excluder devices, and hydrodynamic dredge development.
- Other gear and survey types: Maine Estuaries Diadromous Survey; Nutrients and Frontal Boundaries; Ocean Acidification; AUV Pilot Studies; Finfish Aquaculture Trawling; DelMarVa Habitat Characterization; DelMarVa Reefs Survey; Fish Collection; Opportunistic Hydrographic Sampling; Tagging Projects (Gillnets, Hook & Line); Passive Acoustic Monitoring; Surveys Using Pots & Traps such as scup and black sea bass pot surveys

Given the type of activities and the level of effort, many of the impacts described in the 2016 PEA would be the same and are summarized in the following subsections. The Preferred Alternative would not automatically result in increased effort from Status Quo due to funding limitations.

4.4.1 Effects on the Physical Environment

The effects of the Preferred Alternative on the physical environment and on special resource areas would be similar to those of the Status Quo/ No Action Alternative (Section 4.3.1). The additional mitigation measures for protected species proposed under Alternative 2 (see Table 2-2) would not change the effects of the research activities on physical properties of the environment. The changes to the suite of research activities conducted under the Preferred Alternative would result in minimal changes to the physical effects to the benthic environment relative to the Status Quo Alternative.

4.4.2 Effects on the Biological Environment

As described in Section 4.3.2. for the Status Quo/No Action Alternative, only certain ESA-listed fish, target fish, HMS, ESA-listed marine mammals and non-listed marine mammals, sea turtles and invertebrates have been brought forward for analysis in this SPEA.

4.4.2.1 Effects on Fish

NEFSC-affiliated fisheries research conducted under the Preferred Alternative a would have the same types of effects on fish species as described for the Status Quo/No Action Alternative (Section 4.3.2.1) through mortality and disturbance. There are small changes in the long-term research projects conducted under this alternative (Table 2-2), including the addition of some pelagic trawls and NE Observer Program training cruises. Alternative 2 does not include any additional long-term surveys that would result in consequential increases in catch of any ESA-listed species, target species, HMS, or other fish species compared to the Status Quo/No Action Alternative.

However, Alternative 2 does include additional short-term cooperative research projects that are higher level of effort than those analyzed under the Status Quo/No Action Alternative. Most research activities conducted by the NEFSC are multi-species surveys that cover large areas, involve minimal sampling, and do not target overfished species. Research catches in these surveys are generally very small for uncommon species. However, many of the short-term cooperative research projects are focused on a particular species or group of fish (e.g., flounders) and could catch substantial amounts of targeted fish in a relatively small area, e.g., studies comparing different configurations of commercial fishing gear

Improved reporting requirements implemented by the NEFSC for the cooperative research projects would reduce the likelihood that overfishing would occur on any species or group of fish as flounder.

Fisheries and ecosystem research projects being conducted and funded by the NEFSC over the next five years (and in future five-year periods) could result in the capture of up to 595 Atlantic sturgeon (30 lethal):

- 308 from the NYB DPS (15 lethal)
- 130 from the SA DPS (seven lethal)
- 70 from the CB DPS (four lethal)
- 60 from the GOM DPS (three lethal)
- 14 from the Carolina DPS (one lethal)
- 13 Canadian origin (non-listed)

4.4.2.1.1 ESA-Listed Fish

Overall, the potential effects of bycatch of ESA-listed fishes especially Atlantic salmon and Atlantic sturgeon during NEFSC-affiliated fisheries research conducted under the Preferred Alternative should be considered low in magnitude, distributed over a wide geographic area, and temporary or short-term (for fish captured and released. This is based on the amounts of these fish captured in similar projects conducted between 2008-2012 (NMFS 2016b) and 2017 (including the directed research on Atlantic salmon off West Greenland). Since fish from this DPS have a low risk of being taken during the tagging study, the effect would be considered minor adverse (see Table 4-6). Therefore, the effects would be considered minor adverse according to the criteria at Table 4-1.

4.4.2.1.2 Target and Other Fish

The impact of mortality from fisheries research on target species or stocks under the Preferred Alternative would not be different than that described under the Status Quo/No Action Alternative (Table 4-8), and is representative of research takes in the foreseeable future. Table 4-9 indicates that, while mortality to fish species is a direct effect of the NEFSC surveys and cooperative research projects, there are likely no measurable effects that will occur as a result of these research activities because the research catch represents such a small percentage of the commercial ACL for each species by stock[9]. For all target species in the Northeast region, mortality from NEFSC research activities would be dispersed over a wide geographic area and considered minor adverse for all target species under the Preferred Alternative.

4.4.2.1.3 Highly Migratory Species

The projected increase in short-term cooperative research effort under the Alternative 2 would not target HMS. Impacts to these species would be primarily from long-term research surveys, which would be the same as those analyzed under the Status Quo/No Action Alternative (Table 4-10). Under this alternative, NEFSC and cooperative research surveys would continue to catch HMS sharks intentionally and incidentally to surveys targeting other species, but mortality would likely be low in magnitude,

[9] There are a few exceptions to this such as witch flounder, yellow tail flounder and alewife, but effects of research catch under the Preferred Alternative on these species is expected to be minor as described for the Status Quo Alternative

infrequent, and distributed over a wide geographic area. As described for the Status Quo/No Action alternative these effects would be range from no effect to minor adverse for all species except dusky shark, which would be moderate adverse.

4.4.2.2 Effects on Marine Mammals

Under the Preferred Alternative, the potential direct and indirect effects on marine mammals through M/SI, acoustic disturbance, or changes in prey availability would be similar to those described for the Status Quo/No Action Alternative (Table 4-12) and where effects have been identified, they would be considered minor adverse for all species. In addition, the NEFSC considers the current suite of mitigation and monitoring measures to be necessary to avoid adverse interactions with protected species and still allow the NEFSC and its cooperating partners to fulfill their scientific missions. Most of the mitigation measures currently in place under Status Quo/No Action (Alternative 1, Table 2-3) are also proposed under the Preferred Alternative and would continue to be implemented for the period 2021-2026. For future research, there are minor modifications proposed by NEFSC to mitigation measures as shown in Table 2-3 including but not limited to reducing the pre-set watch time for trawling to 15 minutes (down from 30 minutes).

4.4.2.3 Effects on Sea Turtles

NEFSC fisheries research activities conducted under the Preferred Alternative involve a relatively small number of research vessels, short deployments of fishing gear, and sample sites dispersed over a wide area. Historical takes of sea turtles in NEFSC research gear (summarized in NMFS 2016a) have been primarily in the Southern New England and Mid-Atlantic Bight areas, where the overlap of sea turtle habitat and NEFSC-affiliated research occurs. Future incidental captures of sea turtles under the Preferred Alternative will likely occur but based on past experience and the low number of takes that occurred in 2017 and 2018 (see Table 4-18), it is likely that any captured turtles will be released alive and unharmed. This is due to the short tow and set durations of most NEFSC research activities and the presence of trained turtle-handling personnel on research crews. However, the potential for serious injury and mortality of sea turtles in research gear does exist, especially in those relatively few cooperative research activities that have protocols (i.e., tow durations greater than one hour or long soak times) similar to commercial fishing operations.

The overall effects of the Preferred Alternative on ESA-listed sea turtles would be similar to those described in Section 4.3.2.3 for the Status Quo/No action Alternative and are considered minor in magnitude, dispersed over a large geographic area, and temporary or short-term in duration. Therefore, the potential effects of NEFSC research under Alternative 2 would be considered minor adverse on all species of sea turtles except leatherbacks, which would be no effect.

4.4.2.4 Effects on Invertebrates

The general types of effects of the Preferred Alternative on invertebrate species would be comparable to that described for the Status Quo/No Action Alternative.

Fisheries research in the NEFSC research areas typically targets commercially important invertebrates, including sea scallops, clams, lobsters, squid, and shrimp. Most research mortality of these species occurs

during targeted surveys, but also results from by-catch during other research surveys, such as bottom trawl surveys.

As was done with the Status Quo alternative, the magnitude of the impact of mortality from fisheries research on invertebrates is compared to the amount caught in commercial fisheries, which is well known (Table 4-20). These average annual research catches were compared to the average annual commercial landings of target species in the Northeast Region to give an indication of the relative size of research catches. Research impacts on invertebrates include direct catches from surveys targeting invertebrates and catches incidental to other surveys. As with Status Quo, considering research mortality is very small relative to commercial fisheries, the potential effects of the Preferred Alternative are considered minor adverse on all invertebrates with the exception of Northern shrimp, which would be moderate adverse.

4.4.2.5 Effects on Vegetation

The effects on Johnson's sea grass would be the same as those described for the Status Quo/No action alternative: minor adverse.

4.4.3 Effects on the Social and Economic Environment

The NEFSC fisheries research program has the most potential to affect the social and economic environment through its contribution to the fisheries management process under the Preferred Alternative. As described in Section 3.3, the best available information currently available on fisheries socioeconomics was published in 2018 (NMFS 2018a) and is for the period 2007-2016. Under the Preferred Alternative, the long-term, standardized resource surveys conducted by the NEFSC and its cooperative research partners would continue to provide a rigorous scientific basis for the development of fisheries stock assessments and federal fishery management actions in the Northeast region.

NEFSC fisheries research also provides information on ecosystem characteristics that is essential to management of commercial fisheries. The scientific information provided by the NEFSC is used not just for current management decisions, but also to conserve resources and anticipate future trends, ensure future fishing utilization opportunities, and assess the effectiveness of the agency's management efforts.

The scientific data provided through the long-term and short-term fisheries research conducted and associated with the NEFSC has played an important role in the development of fisheries and conservation policies through informing the fisheries management process.

Cooperative research under the Preferred Alternative will remain an important element in establishing communication, trust, and information exchanges between scientists, fisheries managers, and the fishing industry. Cooperative research is used to: a) increase the precision and expand the scope of resource surveys; b) provide supplemental information about fishing operations; c) incorporate fishing expertise into the design and implementation of research; and d) build mutual understanding and respect among scientists and people in the fishing industry. Collaboration in the development of new gear and techniques encourages participation in developing sustainable fishing practices and contributes to a broader understanding of management for marine resources.

NEFSC-affiliated fisheries and ecosystem research conducted under the Preferred Alternative would provide a rigorous scientific basis for fisheries managers to set optimum yield fishery harvests while protecting the recovery of overfished resources and ultimately rebuilding these stocks to appropriate

levels. It also contributes directly and indirectly to local economies, promotes collaboration and positive relationships between NMFS and other researchers as well as with commercial and recreational fishing interests, and helps fulfill NMFS obligations to communities under U.S. laws and international treaties.

The direct and indirect effects of the Preferred Alternative on the social and economic environment would be certain to occur, minor to moderate in magnitude depending on the community, long-term, and would be widely dispersed throughout the Northeast region. According to the impact criteria established in Table 4-1, the direct and indirect effects of the Preferred Alternative on the social and economic environment would be minor to moderate and beneficial.

5 CUMULATIVE EFFECTS OF THE ALTERNATIVES

This section provides an update to the evaluation of potential cumulative effects of NEFSC fisheries and ecosystem research that was published in the 2016 PEA. A brief summary of notable events or external activities that may interact with research that have occurred since 2015 as well as reasonably foreseeable future events and activities that may occur between 2020 and 2025 are included in this analysis of Alternatives 1 and 2 described in Chapter 2. A publication by Murray *et al.* (2014) provides a detailed discussion of cumulative effects on marine ecosystems from human-caused activities. This section discusses both human-caused and natural stressors that may result in cumulative effects on resources within NEFSC research areas.

5.1 Spatial and Temporal Scope

This cumulative effects analysis considers actions and events where NEFSC surveys occur as described in Section 1.1 and illustrated in Figure 1-1. Some actions that originate outside of NEFSC research areas such as discharge of pollutants or commercial fisheries, could contribute to cumulative effects within these geographic areas of interest. Other changes such as ocean acidification or climate change may be geographically widespread but also affect resources within the NEFSC research areas. The baseline condition described in the 2016 PEA as supplemented where necessary by Chapter 3 of this SPEA serves as the point of reference for analyzing cumulative effects. The temporal scope of this analysis generally covers notable events and actions that have occurred since the 2016 PEA through 2026.

5.2 Relevant Past, Present and Reasonably Foreseeable Future Actions and Events Within the Research Areas

Relevant past and present external actions and events that may interact with NEFSC fisheries and ecosystem research may include both human controlled activities (such as shipping or marine debris), and natural events such as predation or climate change. Reasonably Foreseeable Future Actions (RFFAs; human activities or natural events) are those that:

- Have already been or are in the process of being funded, permitted, or described in coastal zone management plans;
- Are included as priorities in government planning documents; or
- Are likely to occur or continue based on environmental data, or historical patterns.

Judgments concerning the probability of future impacts must be informed rather than based on speculation. RFFAs to be considered must also fall into the temporal and geographic scope described below.

Reasonably foreseeable future actions and natural events were screened for their relevance to the alternatives proposed in this SPEA. Because the regulations in 40 CFR 1508.8 state that the actions and events must be considered probable, not just possible, only those actions that have a “high probability” of occurring have been included for analysis. Future actions and events were categorized as having a high probability of occurring based on whether they have undergone or are currently being evaluated by state or federal agencies, or whether permits have been issued authorizing the activity (i.e., undersea cable

projects). Other activities and natural events categorized as high probability include those that have occurred for several years previously and are likely to continue occurring such as commercial and recreational fisheries, tourism or shipping. Due to the large geographic scope of the research areas, the identification of RFFAs was conducted on a broad scale, although some specific RFFAs were considered where applicable. Table 5-1 provides a list of past, present and RFFAs and natural events considered in the cumulative effects analysis in this SPEA.

Recognizing that not all past, present and future actions and events listed in Table 5-1 result in effects on every resource, only the actions or events that could contribute to cumulative effects are listed in Table 5-2 through 5-7 in the resource-specific discussions below.

TABLE 5-1. PAST, PRESENT AND REASONABLY FORESEEABLE FUTURE ACTIONS AND EVENTS WITHIN THE NEFSC RESEARCH AREAS

Category	Action/Event	Time Period	Location	Additional Description	Current Status	Reference
Renewable Energy	Wind Energy Projects	Multi-year	Coastal and Offshore Areas	As of 2018, there were 12 active commercial leases for offshore wind energy are located in the Outer Continental Shelf (OCS) off the Atlantic coast. USACE published a FONSI for Block Island Wind in 2014 which was adopted by BOEM. In February 2020, BOEM announced a delay in finalizing the EIS for the 800-megawatt Vineyard Wind project, located off Massachusetts.	Ongoing	https://www.boem.gov/renewable-energy https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/Vineyard-Wind-SEIS-Permitting-Timetable.pdf
Renewable Energy	Hydrokinetic, Wave	Multi-year	Coastal and Offshore Areas	In addition to wind energy, the BOEM Outer Continental Shelf (OCS) Region Renewable Energy Program also covers hydrokinetic and wave projects. BOEM supports renewable energy research associated with Operational safety, engineering standards and pollution prevention. 23 active commercial and research renewable energy leases have been issued on the Atlantic coast.	Ongoing	Figure 5-3
Construction	Multiple Coastal Projects U.S. East Coast	Multi-year	Coastal Areas	Construction projects that may interact with the same resources as NEFSC research include but are not limited to port improvement projects, beach improvement projects, golf courses, housing developments, marinas, etc.	Ongoing	Various
Geophysical/ Geotechnical Surveys	Seismic imaging using airguns.	Multi-year	Coastal and Offshore Areas	Federal regulators denied six pending permits for using high-powered airguns to scan the ocean floor for signs of oil and gas deposits from Florida to Delaware. The permits were no longer needed because the federal government removed those waters from the list of areas available to be leased for oil and gas exploration between 2017 and 2022.	Denied	https://www.floridatoday.com/story/news/local/environment/2017/01/06/obama-denies-seismic-airgun-permits-del-fla/96240854/

Category	Action/Event	Time Period	Location	Additional Description	Current Status	Reference
Marine Debris	Derelict fishing Gear	Multi-year	Coastal and Offshore Areas	Fishing for Energy, a partnership between the NOAA Marine Debris Program, the National Fish and Wildlife Foundation, and Covanta Energy is supporting two new projects to prevent and reduce the impacts of derelict fishing gear on the marine environment. In the Chesapeake Bay, the College of William and Mary's Virginia Institute of Marine Science, is working with the community, students, and local watermen to create a marine debris mobile application specifically designed to help anyone record the location, date, and status of derelict crab traps, which can be used to help inform and prioritize removal efforts. Across the Long Island Sound, Cornell Cooperative Extension of Suffolk County is aiming to remove over 3,000 derelict lobster pots using a specialized grapple system to decrease ghost fishing impacts to the depleted Southern New England lobster stock.	Ongoing	https://blog.marinedebris.noaa.gov/removing-derelict-fishing-gear-across-mid-atlantic-region
Marine Debris	Garbage and flotsam	Multi-year	Coastal	Marine debris removal in Jamaica Bay, NY and Chesapeake Bay; removal of balloon litter studies involving the toxicity of microplastics, etc.		https://marinedebris.noaa.gov/mid-atlantic
Marine Sanctuaries and Protected Areas	ONMS	Multi-year	Coastal and Offshore Areas	In 2016, NOAA proposed to expand Monitor NMS to include a collection of nearby World War II shipwrecks known as the "Graveyard of the Atlantic." On August 7, 2018 NOAA published a notice requesting public comment on four draft PEAs related to continued field operations at each of the 13 NMS and two Marine National Monuments.	Ongoing	83 FR 15240 81 FR 879 83 FR 38684 https://sanctuaries.noaa.gov/
Military	USCG	Multi-year	Coastal and Offshore Areas	The Coast Guard's 1st District Headquarters in Boston is responsible for Coast Guard activities in Northern New Jersey, New York, Connecticut, Rhode Island, Massachusetts, New Hampshire, Vermont and Maine. There are 6 ashore units and 6 afloat units (cutters) in the 1st Division.	Ongoing	https://www.atlanticarea.uscg.mil/Our-Organization/District-1/

Category	Action/Event	Time Period	Location	Additional Description	Current Status	Reference
Natural Events	Hurricane/ Typhoon	Multi-year	Global	The Atlantic hurricane season runs from June 1st to November 30th. By the beginning of September in an average year four named systems, two of which would be hurricanes and one of which would be of category 3 or greater in strength would be expected to have occurred.	Ongoing	http://www.nhc.noaa.gov/climo/
Natural Events	Climate Change	Multi-year	Global	Increased ocean temperatures, increased ocean acidity, shift in currents, sea level rise.	Ongoing	https://research.noaa.gov/News/NewsArchive/LatestNews/ArtMID/1768/ArticleID/10457/Mapping-climate-change-in-the-oceans
Oil and Gas	Offshore Exploration	2017-2022	Atlantic region	BOEM's lease sale final program for 2017-2022 excluded a lease sale in the Atlantic region that had been proposed in an earlier version. N BOEM cited conflicts with existing uses, including ocean-dependent tourism, commercial and recreational fishing, commercial shipping and transportation, and Department of Defense and NASA uses for excluding the region.	Not active/ occurring	https://fas.org/sgp/crs/misc/R44504.pdf
Other Research (External to NEFSC and Partners)	Long Term Ecological Research Study		Coastal and Offshore Areas	National Science Foundation (NSF) grants support Long-Term Ecological Research (LTER) sites. The NSF Northeast U.S. Shelf LTER site spans the continental shelf across an area connecting the WHOI-operated Martha's Vineyard Coastal Observatory with the Pioneer Array, part of NSF's Ocean Observatories Initiative. The Pioneer Array, a group of moorings and other instruments, is located off the coast of southern New England where coastal waters meet the open ocean.	Ongoing	https://www.nsf.gov/news/news_summ.jsp?cntn_id=191149
Predation	N/A	Multi-year	Coastal and Offshore Areas	Predation of animals in their environment by natural predators) or introduced predators such as rats that may prey on species such as seabirds or sea turtles (eggs).	Ongoing	Various

Category	Action/Event	Time Period	Location	Additional Description	Current Status	Reference
Recreational Fishing	HMS Fishing Tournaments	Multi-year	Coastal and Offshore Areas	Most HMS tournaments occur in the SE and Gulf of Mexico regions. However, in 2017 a tournament for Mako and in 2019 one for Mako and tuna took place off of the New Jersey coast. Two tournaments for sharks off of New York have been registered for 2020.	Ongoing	https://www.fisheries.noaa.gov/atlantic-highly-migratory-species/atlantic-highly-migratory-species-tournaments
Tourism/ Recreation	Use of Beaches	Multi-year	Coastal and Offshore Areas	NOAA outreach regarding sharing recreational shoreline areas with seals	Ongoing	https://www.fisheries.noaa.gov/new-england-mid-atlantic/marine-life-viewing-guidelines/share-shore-seals-new-england-mid-atlantic
Undersea Cables	Telecommunication	Multi-year	Coastal and Offshore Areas	To help ensure coordination of cable placement and mitigation of any adverse impacts, a number of U.S. agencies have authority to regulate the laying and maintenance of cable off of our nation's shores. In addition, while this webpage focuses on the federal government's authority to regulate submarine cables, it is worth noting that a number of U.S. states also exercise control over submarine cables that land on their shores. E.g., Undersea Cable–Regulatory Framework Created, Haw. Clean Energy Initiative (June 27, 2012)	Ongoing	https://www.gc.noaa.gov/gcil_submarine_cables_domestic.html https://www.submarinecablemap.com/
Vessel Traffic	Shipping	Multi-year	Coastal and Offshore Areas	The Coast Guard is beginning a new study of the port approaches and international entry and departure transit areas to ports on the Atlantic Coast of the United States.	Ongoing	84FR9541

5.2.1 Wind Energy

The Department of the Interior (DOI) published regulations in 2009 for the Outer Continental Shelf (OCS) Renewable Energy Program. DOI's Bureau of Ocean Energy Management (BOEM) is responsible for implementing these regulations, which provide a framework for issuing leases, easements and rights-of-way for OCS activities that support production and transmission of renewable energy, including offshore wind, ocean wave energy, and ocean current energy. In 2016, Block Island Wind located about three miles off the Rhode Island coast, became the first commercial offshore wind energy facility off the U.S. coast. As of 2018, BOEM had 12 active commercial leases in the Atlantic OCS for offshore wind development, six approved Site Assessment Plans and two projects with construction and operations plan being processed (Vineyard Wind and Deepwater Wind South Fork). Figure 5-1 shows the offshore wind projects in the pipeline as of 2018. Figure 5-2 shows locations of Atlantic OCS renewable energy projects, including wind energy, as of March 2020 (BOEM 2020a).

To assist with decision-making and resolve potential conflicts regarding wind energy development, BOEM established Intergovernmental Renewable Energy Task Forces in several states including Delaware, Maine, Maryland, Massachusetts, New Jersey, New York, North Carolina, Rhode Island, South Carolina, and Virginia[10]. Given the regional nature of offshore wind energy development, in January 2019, BOEM also established a Gulf of Maine Task Force – including representation from New Hampshire, Massachusetts, Maine and federally recognized Tribes in the area (BOEM 2020a).

The majority of offshore wind energy facilities are constructed using monopile or jacket foundations that are essentially anchored to the ocean bottom. However, along the Atlantic coast, technological advances may support further investigation of floating turbines located in deeper waters offshore. According to BOEM (2020a), the agency plans to explore this newer technology in the Atlantic through research and a workshop in the near future.

In 2019, BOEM also published a report titled "2019 Atlantic Science Year In Review" (BOEM 2019). The review provides a summary of broad spectrum of studies completed in 2019 to address environmental concerns and issues related to BOEM's Offshore Renewable Energy Program along the Atlantic Coast (BOEM 2019). Several 2019 research projects focused on gathering baseline data on certain marine resources that could be affected by offshore wind including but not limited to:

- Understanding whale presence and seasonal patterns in and around the Virginia Wind Energy Area using passive acoustic monitoring. This study also collected data on ambient sound levels such as from wind/wave action or vessels (https://espis.boem.gov/final%20reports/BOEM_2019-007.pdf);
- Determining habitat use of marine mammals and ambient noise offshore of Maryland (https://espis.boem.gov/final%20reports/BOEM_2019-018.pdf);
- Monitoring Endangered Atlantic Sturgeon and Commercial Finfish Habitat Use Offshore New York (https://espis.boem.gov/final%20reports/BOEM_2019-074.pdf); and

[10]https://www.boem.gov/renewable-energy/state-activities/renewable-energy-task-force-meetings-0

- Evaluation of Potential Electric and Magnetic Field (EMF) Effects on Fish Species of Commercial or Recreational Fishing Importance in Southern New England (https://espis.boem.gov/final%20reports/BOEM_2019-049.pdf).

Due to the number of offshore wind energy projects in the pipeline and the multitude of other ocean uses along the Atlantic coast, BOEM sought to establish a common cumulative impact scenario framework for use in NEPA analyses of these projects (BOEM 2019). The 2019 report identified important cause and effect relationships between offshore wind projects and marine resources and provides a framework to identify relevant past, present and future actions to be considered in future cumulative effects analyses of offshore wind energy development.

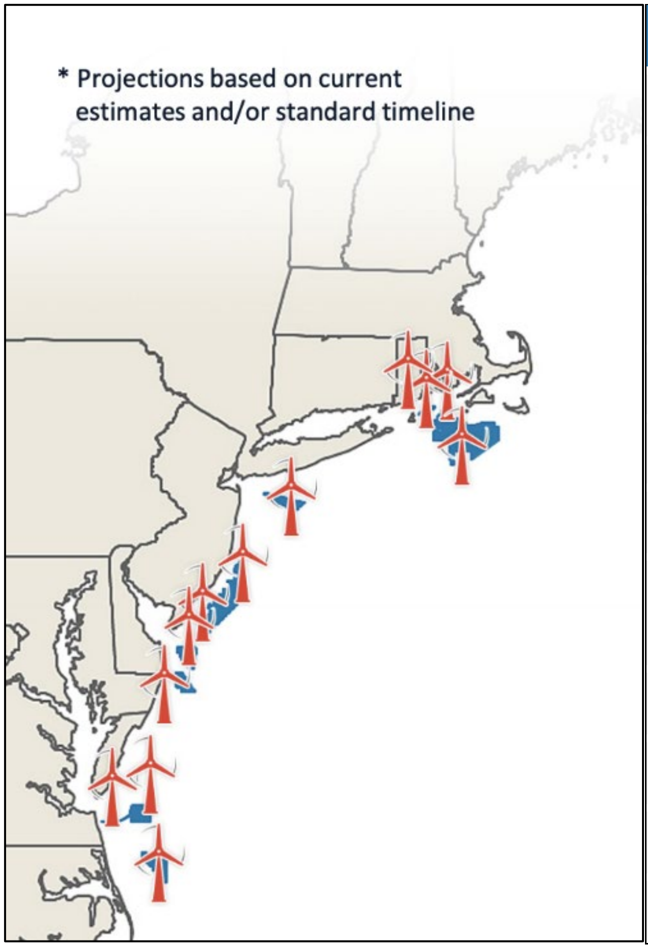
In February 2020, BOEM announced there will be a delay in publishing the Final EIS for Vineyard Wind, an 800-megawatt project located off Massachusetts. According to a timeline published by BOEM for the Vineyard Wind project, a ROD is expected in December 2020 and an MMPA authorization is scheduled by March 2021. Other required federal and state consultations and authorization are listed in BOEM's schedule found at: https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/Vineyard-Wind-SEIS-Permitting-Timetable.pdf.

According to a Supplemental Draft EIS published for the Vineyard Wind project in June 2020 (BOEM 2020b), the proposed wind project could result in:

- Negligible to moderate adverse and moderate beneficial cumulative impacts on benthic resources due to cable placement and maintenance, noise, and presence of structures (potentially beneficial). Benthic resources are expected to recover completely when remedial or mitigating actions are implemented (BOEM 2020b), Page 3-18);
- Negligible to moderate adverse as well as moderate beneficial cumulative impacts on finfish, invertebrates and EFH due to underwater noise, presence of structures and cable installation when combined with fishing mortality, climate change and bottom-tending fishing gear. While a major adverse impact is possible if invasive species are introduced during construction, BOEM considers this unlikely. The presence of structures could be beneficial to some fish and invertebrates (BOEM 2020b), Page 3-28);
- Negligible to moderate adverse impacts and moderate beneficial impacts on marine mammals due to pile driving, vessel and construction noise, increased vessel traffic and ongoing climate change. BOEM states that while a notable and measurable impact is anticipated, marine mammals are likely to recover completely when mitigation measures are implemented ((BOEM 2020b), Page 3-42).
- Negligible to moderate adverse impacts and moderate beneficial impacts on sea turtles due to pile driving noise, presence of structures, ongoing climate change and ongoing vessel traffic posing a collision risk however sea turtles are expected to recover completely when mitigation is implemented ((BOEM 2020b), Page 3-53);
- Negligible to major cumulative impacts to commercial fishing and for-hire recreational fishing due to potential changes in fish distribution/availability due to climate change, reduced stock levels due to fishing mortality, and permanent impacts due to the presence of structures (cables and foundations). These permanent structures from the Vineyard Wind project could cause

> navigation hazards, gear loss and damage, and space use conflicts. Major adverse impacts to for-hire recreational fishing are expected due to unavoidable disruptions during construction, etc. beyond normal levels, however mitigation including financial compensation and inform spacing could reduce these types of effects (BOEM 2020b), Page 3-101).

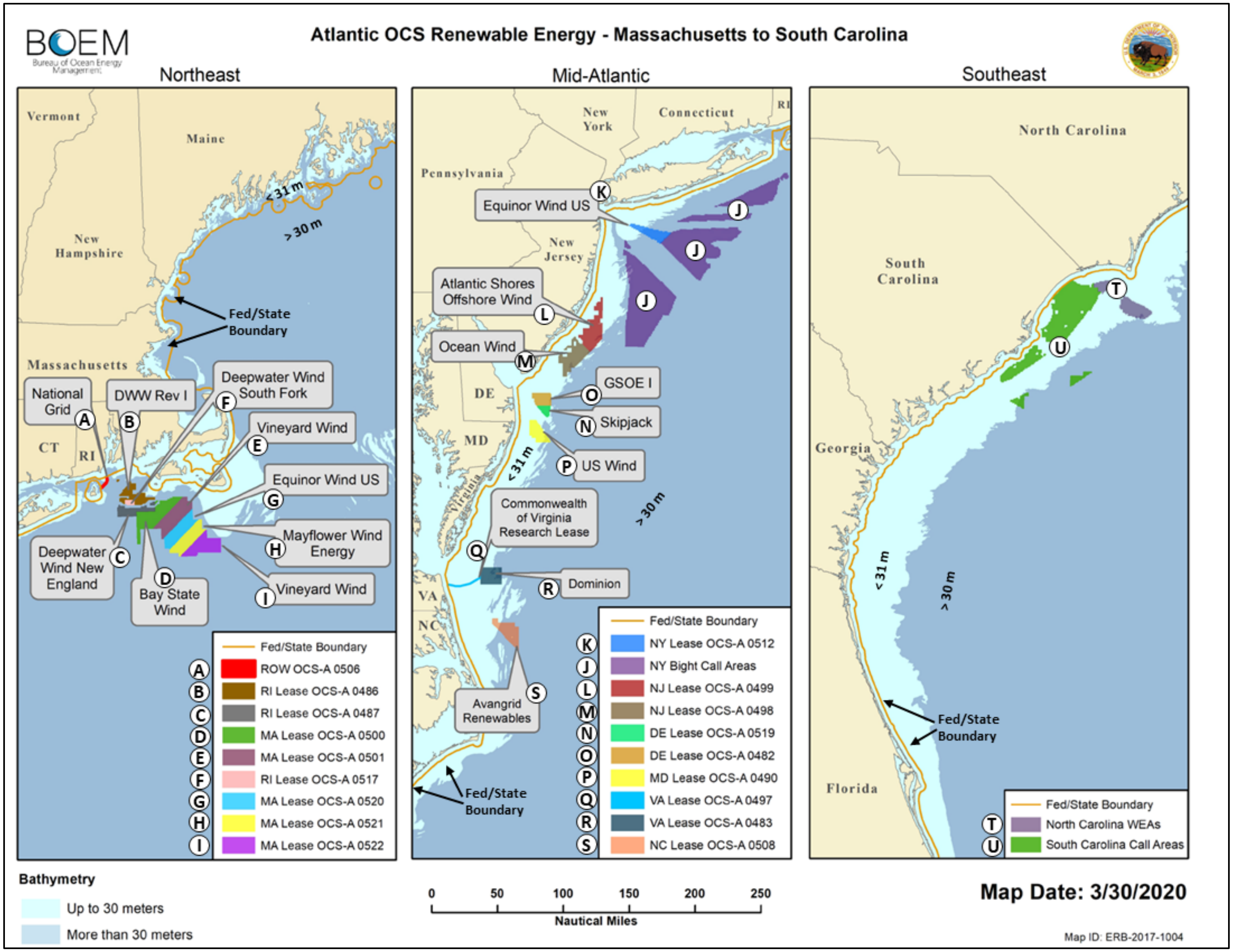
While the potential cumulative effects described here are specific to BOEM's analysis of the proposed Vineyard Wind project, similar types of cumulative effects are reasonably foreseeable with other proposed offshore wind energy projects in the Atlantic (sees Figure 5-1 and 5-2). For additional information, a list of recent studies on the potential effects of offshore wind energy on social, economic and environmental resources can be found at: https://www.boem.gov/environment/environmental-studies/renewable-energy-research-completed-studies.



Year	Project	Company
2020	Coastal Virginia Offshore Wind	DMME and Orsted
2021	Vineyard Wind	Vineyard Wind
2022	South Fork	Deepwater Wind
2022	Ocean Wind	Orsted
2022	Bay State Wind	Bay State Wind
2022	U.S. Wind (Maryland)	US Wind
2023	Revolution Wind	Deepwater Wind
2023	Skipjack Windfarm	Garden State Offshore and Deepwater Wind
2024	Empire Wind	Equinor Wind US
2025	Dominion Commercial Lease	Dominion Energy
2026	U.S. Wind (New Jersey)	US Wind
2027	Kitty Hawk	Avangrid Renewables

Source: https://s23.a2zinc.net/clients/awea/owp2019/Custom/Handout/Speaker11709_Session5061_1.pdf

FIGURE 5-1. ATLANTIC OCS OFFSHORE WIND PROJECTS IN THE PIPELINE



Source: Atlantic OCS Offshore Renewable Energy Project Locations

FIGURE 5-2. ATLANTIC OCS OFFSHORE RENEWABLE ENERGY PROJECT LOCATIONS

COMPANION TABLE TO FIGURE 5-2: Atlantic OCS Offshore Renewable Energy Project Locations (as of 03/30/2020)

Region	Map Code	Location	Contract	Company
Northeast	A	10 miles off Rhode Island coast, in deep water	ROW OCS-0506	National Grid
	B	25 miles off Rhode Island coast, in deep water	RI Lease OCS-A-0486	Deep Water Wind Rev I
	C	30 miles off Rhode Island coast, in deep water t	RI Lease OCS-A-0487	Deepwater Wind New England
	D	25 miles south of Martha's Vineyard Island (MVI), in deep water	MA Lease OCS-A-0500	Bay State Wind
	E	30 miles south of MVI, in deep water	MA Lease OCS-A-0501	Vineyard Wind
	F	27 miles off RI coast, in deep water	MA Lease OCS-A-0517	Deepwater Wind South Fork
	G	35 miles south of MVI, in deep water	MA Lease OCS-A-0520	Equinor Wind
	H	40 miles south of MVI, in deep water	MA Lease OCS-A-0521	Mayflower Wind Energy
	I	45 miles south of MVI, in deep water	MA Lease OCS-A-0522	Vineyard Wind
Mid-Atlantic	J	25-75 miles off coasts of NJ and Long Island	NY Bight Call Areas	Equinor Wind
	K	25-50 miles off coast of northern NJ	NY Lease OCS-A-0512	Equinor Wind
	L	20 miles off coast of central NJ, in shallow water	NJ Lease OCS-A-0499	Atlantic Shores Offshore Wind
	M	20 miles off coast of southern NJ, in shallow water	NJ Lease OCS-A-0498	Ocean Wind
	N	30 miles off Delaware coast, in shallow water	DE Lease OCS-A-0519	Skipjack
	O	30 miles off Delaware coast, in shallow water	DE Lease OCS-A-0482	GSOE I
	P	25 miles off northern Maryland coast, in shallow water	MD Lease OCS-A-0490	US Wind
	Q	Extending out to sea in a curved line from a midpoint on Virginia's coast for 25 miles, to the edge of deep water	VA Lease OCS-A-0497	Commonwealth of VA Research Lease
	R	40 miles off Virginia cost	VA Lease OCS-A-0483	Dominion Energy
	S	50 miles off North Carolina coast, on the edge of deep water	NC Lease OCS-A-0508	Avangrid Renewables
Southeast	T	20 miles off coast of southern North Carolina, in shallow water	North Carolina WEAs	unspecified
	U	0-30 miles off the coast of northern South Carolina	South Carolina Call Areas	unspecified

5.2.2 Climate Change

Sea-level rise, warming ocean temperatures, fluctuations in ocean chemistry changes, and other greenhouse gas-driven changes to the U.S. east coast and oceans are occurring and are projected to have significant consequences for the coastal economy, communities, ecosystems, culture, and heritage. These consequences will affect areas within the NEFSC research areas off the U.S. east coast that have the potential to extend into the U.S. economy. Climate change is increasing ocean temperature and levels of carbon dioxide resulting in ocean acidification and shifting weather patterns (Koetse and Rietveld 2009, Hoegh-Guldberg and Bruno 2010). The increase in temperature and changes in weather patterns may shift currents carrying waste and debris. In marine ecosystems, changes in temperature, ocean circulation, stratification, nutrient input, oxygen content, ocean acidification and increased atmospheric carbon dioxide may have significant biological effects (Donney *et al.* 2012).

In 2016, NMFS released the Northeast Regional Action Plan to address warming ocean waters (Hare, Borggard, *et al.* 2016). The plan prioritizes tracking change, forecasting conditions, assessing risks, and evaluating strategies for managing resources under changing conditions. Under this framework and using methodologies for assessing vulnerability of marine fish and shellfish described in Morrison *et al.* (2015), Hare, Morrison, *et al.* (2016), assessed the climate vulnerability of 82 fish and invertebrate species in the Northeast region. NMFS developed an online tool for accessing species-specific results[11]. These results for fish and invertebrate species analyzed in this SPEA are summarized below in Sections 5.2.3.1 and 5.2.3.5.

Also, as part of the Regional Action Plan, Lettrich *et al.* (2019)published a method for assessing the vulnerability of marine mammals to climate change. Their method follows the model of the NOAA Fisheries Marine Fish and Shellfish Climate Vulnerability Assessment (Hare, Morrison, *et al.* 2016). The method developed by Lettrich *et al.* (2019)uses existing information and expert knowledge to assess marine mammal stocks' exposure, sensitivity, and capacity to adapt to climate change and variability. The method assesses exposure to climate change by scoring the projected change in climate conditions within a stock's current distribution. Sensitivity and capacity to adapt to climate change are then assessed based on the understanding of a stock's life history traits. Figure 5-3 depicts the marine mammal vulnerability assessment progress.

Following Lettrich *et al.* (2019), an assessment of the vulnerability of 108 species of marine mammals in the Atlantic Ocean, Gulf of Mexico and Caribbean Sea is in progress[12]. A sea turtle vulnerability assessment is also in progress. Current information on marine mammals and turtles and climate change is summarized in Sections 5.2.3.2 and 5.2.3.4.

Colburn *et al.* (2016), developed new indicators to assess the impact of sea level rise on critical commercial fishing infrastructure and the dependence of communities on species identified as vulnerable to the effects of climate change. Understanding climate stressors can provide policy makers with knowledge to develop adaptive management strategies that will improve the resiliency of coastal fishing communities. The indicators, as they apply to the NEFSC research area, are summarized in Section 5.2.4.

[11] https://www.st.nmfs.noaa.gov/ecosystems/climate/northeast-fish-and-shellfish-climate-vulnerability/species-vulnerability-distribution
[12] https://www.fisheries.noaa.gov/national/climate/climate-vulnerability-assessments

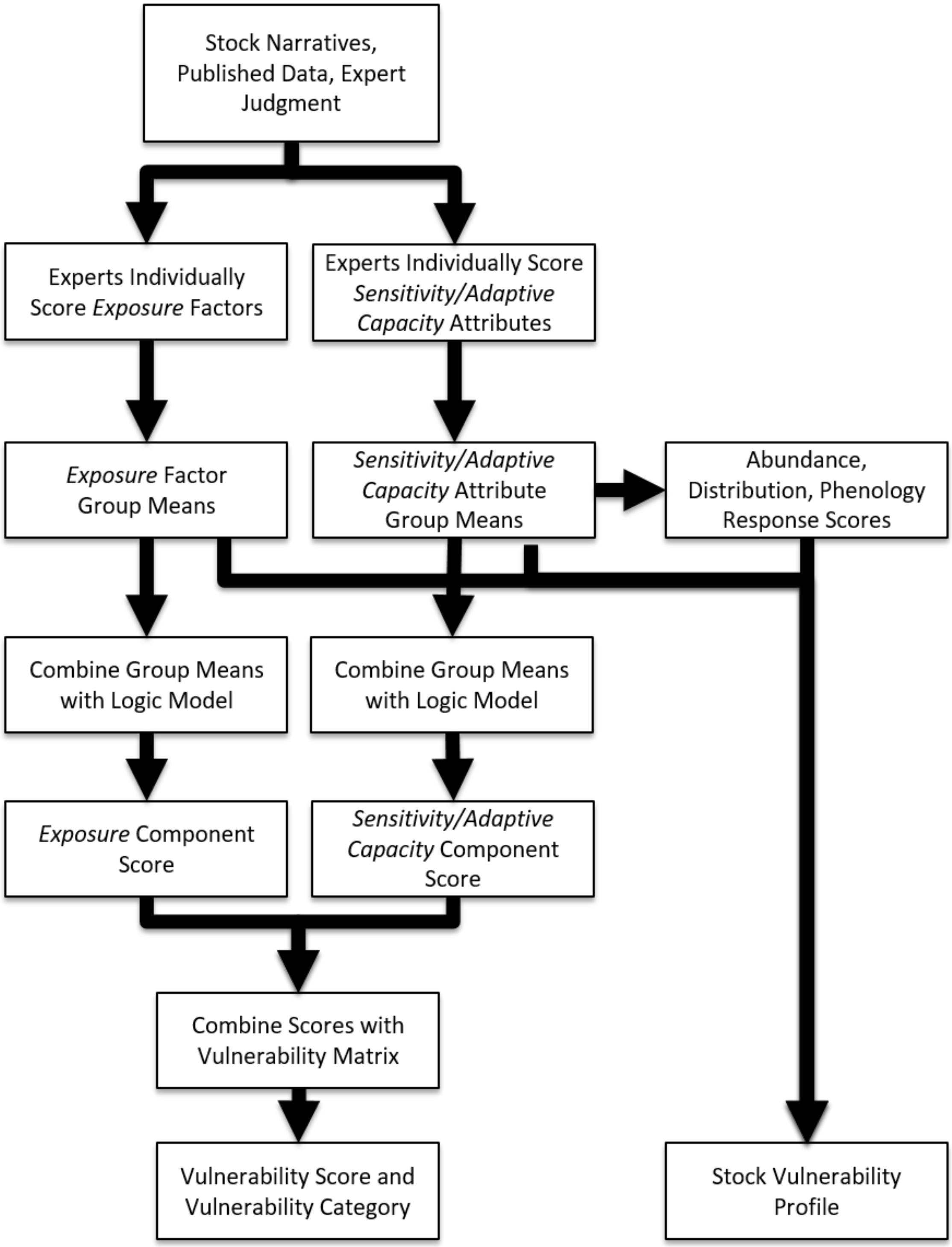


FIGURE 5-3. MARINE MAMMAL CLIMATE VULNERABILITY ASSESSMENT PROCESS

Source: Lettrich *et al.* (2019)

5.2.3 Physical Environment

Dozens of trans-Atlantic undersea cables occupy the seafloor that run through the NEFSC research area off the U.S. east coast (see Figure 5-4). Modern cables are typically about 1 inch in diameter and weigh about 2.5 tons per mile. These cables disturb the benthic habitat, however studies have indicated that cables pose minimal threats to the benthic environment, and in some cases provide habitat for invertebrates to grow (Carter 2009). Wind farms could also affect the geologic features of research areas where the anchors are set. Sediment disturbance, noise and vibration during wind subsea cable installation, placement of turbine foundations and construction would occur, along with some habitat loss due to permanent structures being placed on the seafloor (Michel *et al.* 2007). As described in Section 5.2.1, negligible to moderate adverse cumulative impacts from wind also include installation of cables and underwater noise however, the presence of new structures (i.e., piles/foundations) may benefit certain benthic resources (BOEM 2020b). Military training is unlikely to impact offshore geologic resources, although missile testing, and other exercises may accumulate munitions and other military hardware on the seabed. Natural disasters known to occur in the region (i.e., tsunamis, hurricanes, typhoons) could cause the deposition of various debris and structures on the seabed as well.

Overall, the cumulative effects of proposed NEFSC fisheries and ecosystem research when combined with other past, present and future actions, would likely result in negligible cumulative effects on the physical environment. Large objects deposited on the seabed such as from marine debris, undersea cables or wind farms, would have an impact, although sometimes these objects may create new habitat in a relatively homogenous, flat environment. Nevertheless, the spatial extent of these impacts would involve a small, localized area. While effects from actions external to NEFSC research could be long-term, the magnitude of NEFSC research is not expected to alter habitat function or cause wide-spread changes to the geologic structure of the research areas (see Table 5-2).

TABLE 5-2. PAST, PRESENT AND RFFAS POTENTIALLY AFFECTING PHYSICAL FEATURES AND BENTHIC HABITAT

RFFA or Natural Event	Net Effect	Types of Effects
Renewable Energy Projects	Minor *Adverse*	• Benthic disturbance
Undersea Cables	Minor *Adverse*	• Benthic disturbance
Military Training and Testing	Minor *Adverse*	• Benthic disturbance • Munitions and other military hardware on the seabed
Marine Protected Areas/EFH/Closed Areas	Major *Beneficial*	• Reduced disturbance • Habitat protection and recovery
Hurricanes, Typhoons, Tsunamis	Minor to Moderate *Adverse*	• Potential for equipment, vessels, and land-based structures to be deposited on seabed • Habitat alteration
Climate Change	Minor *Adverse*	• Habitat alteration
Port and Harbor Construction	Minor to Moderate *Adverse*	• Nearshore benthic disturbance • Nearshore habitat alteration
Scientific Research	Minor *Beneficial and Adverse*	• Gain knowledge of seafloor • Benthic disturbance

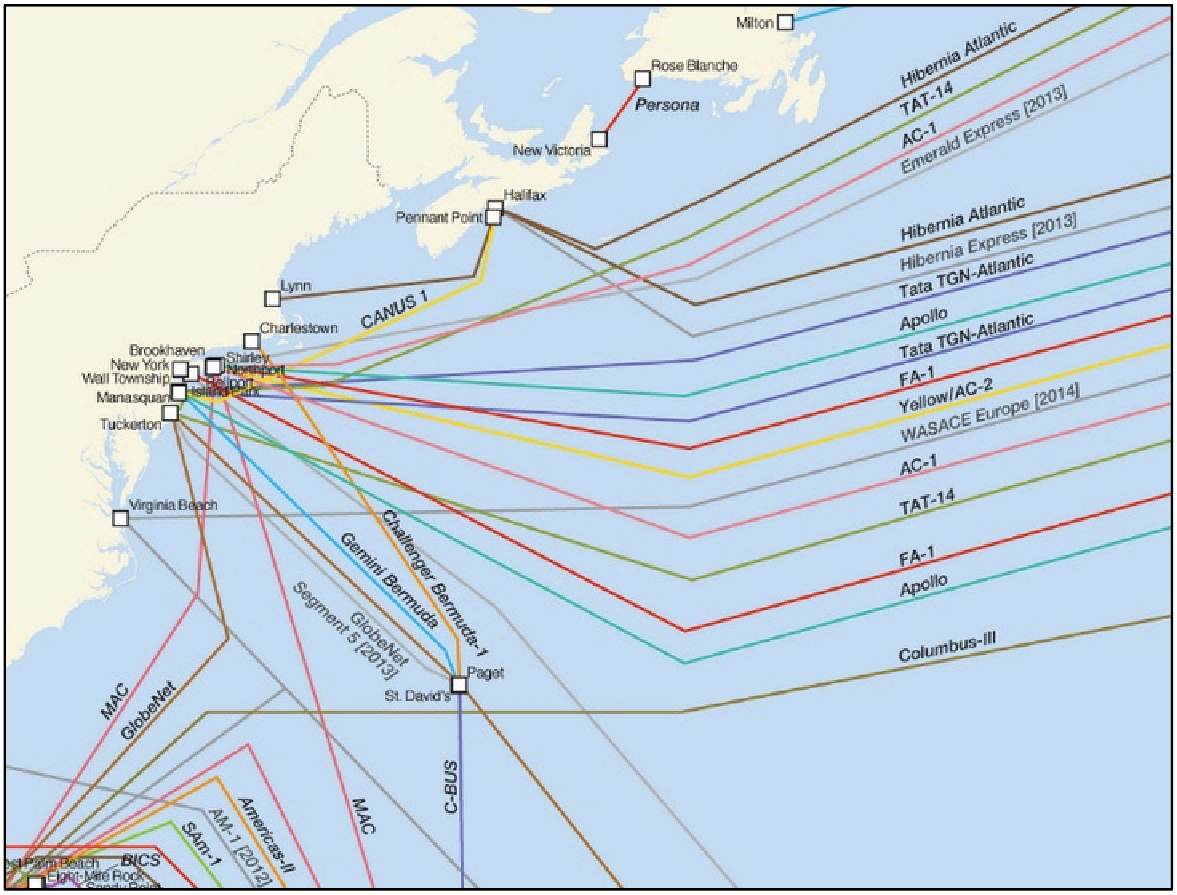


FIGURE 5-4. TRANSATLANTIC SUBSEA CABLES

Source: www.Telegraphy.com

5.2.3.1 Special Resource Areas and EFH

Special marine resource areas often straddle regulatory boundaries. An MPA, signed into law by EO 13158, is defined as "any area of the marine environment that has been reserved by federal, state, tribal, territorial, or local laws or regulations to provide lasting protection for part or all of the natural and cultural resources therein". Not all special sensitive marine areas are set aside for protection by federal or state laws or regulations.

As shown in Table 3-1, in 2016, NOAA proposed to expand Monitor NMS to include a collection of nearby World War II shipwrecks known as the "Graveyard of the Atlantic." And the Omnibus Essential Fish Habitat Amendment 2 revised essential fish habitat and habitat area of particular concern designations, revised or created habitat management areas, including gear restrictions, to protect vulnerable habitat from fishing gear impacts, and established dedicated habitat research areas, and implements several administrative measures related to reviewing these measures, as well as other regulatory adjustments to implement these measures.

In addition, in Amendment 1 to the 2006 Consolidated Atlantic HMS FMP updates and considers new habitat areas of HAPCs for Atlantic HMS based on new information; minimizes to the extent practicable the adverse effects of fishing on EFH; and identifies other actions to encourage the conservation and

enhancement of EFH (82 FR 42329). The combination of new and revised EFH and special resource areas is anticipated to minimize adverse impacts to groundfish EFH from the effects of fishing. Any potential cumulative impacts due to this change are expected to be beneficial. EFH and special resources area may also be adversely impacted by wind energy projects as described in Section 5.2.1 due to minor changes to the seafloor, presence of structures, cable installation and increased underwater noise (BOEM 2020b). Michel *et al.* (2007) also described potential loss or alteration of EFH (or fish habitat) due to sediment suspension and disturbance during construction phases. Subsea cables as shown in Figure 5-4 likely caused temporary adverse impacts to soft substrates which would have been expected to recover once construction is complete, however harder substrates may have experienced more long-term effects when subsea cables were installed. Future cable installations would be expected to result in similar adverse cumulative effects on EFH.

5.2.4 Biological Environment

5.2.4.1 Fish

Cumulative effects on fish and fish populations are complex and while there is a body of evidence on the effects of a single stressor on fish populations, identifying the consequences (and the causes) of multiple stressors is more complex (Murray *et al.* 2014). That said, fisheries research has documented multiple stressors from single fishing types. For example, stressors from benthic trawling include direct mortality to target species, bycatch mortality and injury, sedimentation, and habitat destruction (Hiddink *et al.* 2006). The spatial scale of the cumulative effects of a single activity can vary across local and regional scales, as well as their duration and frequency over time. While direct mortality from fisheries may occur only within a fished area, sedimentation may be widespread and habitat destruction could be long-term (Watling and Norse 1998; Boutillier 2012, as cited in (Murray *et al.* 2014). The consequences of these cumulative effects also depends heavily on the condition (i.e., health) of the resource exposed. For example, an ESA-listed species would be more vulnerable to long-term consequences of cumulative effects than a non-listed species. Table 5-3 summarizes cumulative effects on fish and climate change and external factors potentially affecting fish are discussed in the following subsections.

TABLE 5-3. PAST, PRESENT AND RFFAS POTENTIALLY AFFECTING FISH

RFFA or Natural Event	Net Effect	Types of Effects
Renewable Energy Projects	Minor *Adverse*	• Alter distribution and migration • Mortality due to targeted fishing
Commercial and Recreational Fishing	Minor to Moderate *Adverse*	• Mortality • Alter species composition through targeting specific species
Undersea Cables	Minor *Adverse*	• Potential effects from electromagnetic fields
Military Training and Testing	Minor *Adverse*	• Habitat disturbance • Mortality • Potential exposure to contaminants
Tourism/Ocean Economy	Minor *Adverse*	• Disturbance • Alter distribution and migration
Marine Protected Areas/EFH/Closed Areas	Major *Beneficial*	• Reduced Disturbance • Habitat protection • Reduced mortality • Enhanced productivity
Climate Change	Minor to Major *Adverse*	• Habitat alteration • Alter distribution and migration • Changes in prey availability (**i.e**., increase or decrease)
Vessel Traffic	Minor to Major *Adverse*	• Habitat disruption • Underwater noise • Spills of contaminants

5.2.4.1.1 Climate Change

Climate change is having effects on weather patterns, water temperatures, ocean acidification, hydrographic conditions, and circulation patterns, all of which may contribute to shifts in the distribution of fish populations which are already occurring in the northwest Atlantic. Marine fish and invertebrate species are impacted by climate change and decadal variability. Free *et al.* (2019) looked at historical abundance data for 124 species in 38 regions, which represents roughly one-third of the reported global catch. The researchers compared this data to records of ocean temperature and found that 8 percent of populations were significantly negatively impacted by warming, while 4 percent saw positive impacts. Overall, the losses outweigh the gains. Recent publications have documented shifts in fish distributions in the northwest Atlantic, mostly northerly shifts in response to ocean warming (Nye *et al.* 2009, Bell *et al.* 2015). Future changes in distribution are predicted by models (Kleisner *et al.* 2017). Species that have already moved northwards or into deeper water to avoid warming bottom waters in the summer and fall include black sea bass, scup, yellowtail flounder, red hake, silver hake, American shad, and alewives. In the Gulf of Maine, gains in thermal habitat are predicted for lobster and spiny dogfish and losses for redfish, plaice, cod, and haddock.

As described in Section 5.2.1, Hare, Morrison, *et al.* (2016), assessed the climate vulnerability of 82 fish and invertebrate species in the Northeast region[13]. Overall, climate vulnerability was high to very high for approximately half the species assessed on the northeast continental shelf; diadromous and benthic invertebrate species exhibit the greatest vulnerability (Hare, Morrison, *et al.* 2016). Ocean temperatures, shallow-water temperatures, and ocean acidification were the climate factors with the largest magnitude of expected changes. In addition, the majority of species included in the assessment have a high potential for a change in distribution in response to projected changes in climate. A subsequent change in distribution of fishery landings and potentially the distribution and magnitude of fishing effort were documented by Hare, Morrison, *et al.* (2016).

The climate vulnerability assessment included 18 of the 25 fish species analyzed in Section 4.3.2.1 (Tables 4-6, 4-8, and 10). The results for these species are summarized in Table 5-4.

TABLE 5-4. CLIMATE VULNERABILITY OF FISH SPECIES ANALYZED IN THIS SPEA

Fish Species	Biological Sensitivity	Climate Exposure	Overall Vulnerability Rank
Atlantic Salmon	Very high	Very high	Very high
Atlantic Sturgeon	High	Very high	Very high
Alewife	High	Very high	Very high
Atlantic cod	Moderate	High	Moderate
Atlantic halibut	High	High	High
Atlantic herring	Low	High	Low
Atlantic mackerel	Moderate	High	Moderate
Atlantic wolffish	High	High	High
Ocean pout	High	High	High
Red hake	Low	High	Low
Striped bass	High	Very high	Very high
Thorny skate	High	High	High
Weakfish	Low	Very high	Moderate
Windowpane flounder	Low	High	Low
Winter flounder	High	Very high	High
Witch flounder	High	High	High
Yellowtail flounder	Low	High	Low
Atlantic dusky shark	High	High	High

Source: https://www.st.nmfs.noaa.gov/ecosystems/climate/northeast-fish-and-shellfish-climate-vulnerability/species-vulnerability-distribution

[13] https://www.fisheries.noaa.gov/new-england-mid-atlantic/climate/northeast-vulnerability-assessment

Overall, the potential far-reaching impacts of climate change on fish habitat due to warming ocean temperatures, decreased habitat for selected species, changing distributions and abundance, changes in productivity and subsequent production, far exceed the minor impacts of fish removal as a result of NEFSC fisheries research.

5.2.4.1.2 Offshore Wind Energy

As described in Section 5.2.1, minor to moderate adverse impacts due to temporary disturbance during construction to install the undersea cable and foundations for the turbines. New structures (i.e., turbine foundations) would result in permanent impacts however, some fish species may benefit from these structures because of them creating new habitat where previously there was none. Wind energy could also result in increased underwater noise and vessel traffic during construction (BOEM 2020b). Habitat alteration, underwater noise, sediment suspension and changes in prey distribution due to wind and other renewable energy combined with undersea cables, and climate change will affect fish populations although the magnitude of such effects cannot be determined without understanding site-specific and species-specific context. According to a synthesis of research on these topics compiled by (Michel *et al.* 2007), these site-specific details are critical to understanding impacts on fish and fish habitats.

5.2.3.1.3 Other External Factors

Other activities in the action area that may affect fish recreational and commercial fisheries, renewable energy, predation, MPAs, construction and military activities. Table 5-3 lists the past, present and RFFAs that have or could affect fish. When considering NEFSC research with other past, present and future actions, cumulative effects on fish overall are minor. The overall level of biomass removal compared to commercial and recreational fisheries is very low.

Globally, a publication by Crowder *et al.* (2008), presented information on the impacts of fisheries (i.e., commercial recreational and artisanal) on marine ecosystems. Researchers have attributed fishing as one of the oldest and most significant factors modifying marine ecosystems (Jackson *et al*. 2001 as cited in (Crowder *et al.* 2008). Fishing, combined with other anthropogenic stressors, has resulted in a loss of biodiversity (Worm *et al*. 2006 as cited in (Crowder *et al.* 2008). Bycatch of sharks and rays in commercial fisheries generally occurs outside of the NEFSC research areas or are from non-listed populations (NMFS 2018a). However, closed areas within NEFSC research areas protect fish and their habitat from some stressors (such as fishing) listed in Table 5-3.

Overall, the contribution of NEFSC research on fish is negligible and could be considered positive when considering overall benefits from new information gained through research.

5.2.4.2 Marine Mammals

Numerous natural and anthropogenic threats to marine mammals in the NEFSC research areas may affect their continued existence. These threats include oceanic and climatic regime shifts, habitat degradation, fisheries interactions, vessel strikes, and disease and other disturbances associated with human activities (see Table 5-5). Fishery interactions with protected species are considered as having the greatest impact on marine mammals worldwide. For example, more than 97 percent of whale entanglements are caused by derelict fishing gear (Baulch and Perry 2014). These impacts are routinely evaluated by NMFS through the preparation and issuance of environmental impact analyses and biological opinions as well as

SARs. Detailed information on bycatch of ESA-listed marine mammals in U.S. commercial fisheries in areas where NEFSC conducts research is monitored on an annual basis. Information from the most recent SARs can be accessed here: https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessment-reports-species-stock

TABLE 5-5. PAST, PRESENT AND RFFAS POTENTIALLY AFFECTING MARINE MAMMALS

RFFA or Natural Event	Net Effect	Types of Effects
Renewable Energy Projects	Minor Adverse	• Disturbance • Changes in prey distribution • Potential entanglement leading to injury or mortality
Commercial Fishing	Minor to Moderate Adverse	• Potential entanglement leading to injury or mortality
Undersea Cables	Minor Adverse	• Disturbance • Potential entanglement leading to injury or mortality
Military Training and Testing	Minor Adverse	• Disturbance • Potential ship strike leading to mortality or injury • Potential exposure to contaminants
Whale/Dolphin Watching; Shark Tours	Minor Adverse	• Disturbance
Cruise Ships, Shipping	Minor to Moderate Adverse	• Disturbance • Potential ship strike leading to mortality or injury • Introduced non-native species • Potential exposure to contaminants
Marine Debris	Minor to Major Adverse	• Mortality and serious injury • Habitat modification
Marine Protected Areas/EFH/Closed Areas	Major Beneficial	• Reduced Disturbance • Habitat protection • Reduced risk of entanglement or ship strike
Other Research	Minor Adverse to Major Beneficial	• Disturbance • Mortality • Habitat protection • Habitat alteration
Hurricanes, Typhoons, Tsunamis	Minor to Moderate Adverse	• Disturbance • Habitat alteration • Potential exposure to contaminants • Mortality or injury
Port and Harbor Construction	Minor to Moderate Adverse	• Disturbance • Habitat alteration • Potential exposure to contaminants
Climate Change	Minor to Major Beneficial and Adverse	• Mortality or injury • Habitat alteration • Introduced non-native species • Changes in prey availability (increase or decrease)
Vessel Traffic	Minor to Major Adverse	• Mortality • Habitat disruption • Underwater noise • Spills of contaminants

5.2.4.2.1 Unusual Mortality Events and Ship Strike

Collisions between ships and marine mammals, particularly large whales, are increasing worldwide (Schoeman *et al.* 2020). Collision-related mortality on species and (sub)populations is not well-understood (Thomas *et al.* 2016; as cited in (Schoeman *et al.* 2020). High mortality rates or a decline in fertile animals could cause population growth rates to decrease which is a significant concern for long-lived marine species (Heppel *et al*. 1999; as cited in (Schoeman *et al.* 2020). Over time, it is possible that vessel-related mortality might exceed the recruitment rate, either through contributing to a cumulative mortality rate (i.e., mortality from both natural and human-related causes) or on its own (Kraus *et al.* 2005, Van der Hoop *et al.* 2012, Fais *et al.* 2016).

Of particular concern in the NEFSC research area is the endangered population of North Atlantic right whales. An Unusual Mortality Event (UME) was declared for North Atlantic right whales in 2017. Over the past three years, 31 whales in Canada and the U.S. have been documented dead and an additional 10 have been documented alive but with serious injuries (41 whales total). Most of the mortalities or injuries have been attributed to either vessel strikes or entanglements. Given there are only ~400 individual North Atlantic right whales remaining, those 41 individuals in the UME represent approximately 10% of the population, which is a significant negative impact on such a critically endangered species.

The probability of a ship strike increases in areas where vessel traffic and marine mammal densities are both high and while more concern has been raised about large vessels, the potential for marine mammal collisions with smaller vessels (<15 m) still exists, especially if vessels are traveling at high speeds (Ritter *et al.* 2012; as cited in (Schoeman *et al.* 2020).

5.2.4.2.2 Climate Change

Cumulative effects of climate change on marine mammals result in changes in sea temperature, prey availability, changes in the frequency of major storm events and changes in habitat. As described in Moore and Huntington (2008), certain marine mammal species may have greater ability than others to adapt to major climate shifts and ecosystem disturbances. It is difficult to predict how cumulative effects may impact specific marine mammal species in any given location however, the contribution of climate change to cumulative effects could range from minor to major depending on the specific species and the context of their exposure to other stressors such as the proposed aquaculture program. The most likely impact of climate change on cetaceans could be changes in the area these species currently occupy due to changes in distribution of prey species with particular thermal requirements (81 FR 62259). According to McLeod (2009), ranges of approximately 88 percent of cetaceans may be affected by changes in water temperature resulting from global climate change.

Lettrich *et al.* (2019)developed a method for assessing the vulnerability of marine mammals to a changing climate. The method uses existing information and expert elicitation to assess marine mammal stocks' exposure, sensitivity, and capacity to adapt to climate change and variability and follows the approach used in NOAA Fisheries Marine Fish and Shellfish Climate Vulnerability Assessment. Exposure to climate change is assessed by scoring the projected change in climate conditions within a stock's current distribution. Sensitivity and capacity to adapt to climate change are assessed based on an understanding of a stock's life history traits. The assessment method will be first applied to marine mammal stocks in the western North Atlantic, Gulf of Mexico, and Caribbean.

5.2.4.2.3 Other External Factors

As discussed in Sections 4.3.2.2 and 4.3.3.3, the proposed NEFSC research would likely result in no effect or minor adverse direct and indirect effects on marine mammals. As described in Section 4.3.2.2, lethal takes of marine mammals by NESC research activities are rare; no lethal takes occurred in 2017 and 2018 and only one occurred in 2019. NEFSC research also disturbed a certain number of marine mammals due to vessel presence and underwater noise. These effects are not expected to result in population-level changes to any species.

A summary of potential past, present and RFFAs that may contribute to cumulative effects on marine mammals is presented in Table 5-5. The majority of impacts on marine mammals arising from RFFAs are associated with potential collision, entanglement, disturbance (including vessel or human presence and underwater noise), habitat alteration, and potential exposure to contaminants (*i.e.*, due to spills). These impacts arise from vessel activities, commercial fisheries, undersea cables, tourism, shipping and cruise ships, and wind farm construction and operations occurring or proposed to occur within or near the research areas. Figure 5-2 presents the location of renewable energy projects and leases in the Atlantic. Figure 5-5 is an example of vessel traffic within the NEFSC research areas.

Marine managed areas protect healthy diverse ecosystems. Marine mammals benefit from these protected areas due to reduced disturbance, protection of prey species, reduced risk of entanglement or collision, among other benefits. The sanctuaries located within NEFSC research areas have beneficial effects which may offset some adverse cumulative effects from other human-induced or natural events

The cumulative effects of hurricanes and tsunamis could cause changes in prey distribution or result in injury or mortality to marine mammals. The extent and magnitude of such impacts would depend on the storm event and the number of animals affected.

The combined cumulative effects on marine mammals of climate change and proposed NEFSC research is considered minor adverse under Alternatives 1 and 2. Relative to RFFAs, the frequency and duration of NEFSC research under Alternatives 1 and 2 is infrequent and short-term, particularly within the context of other past, present and RFFAs listed in Table 5-1.

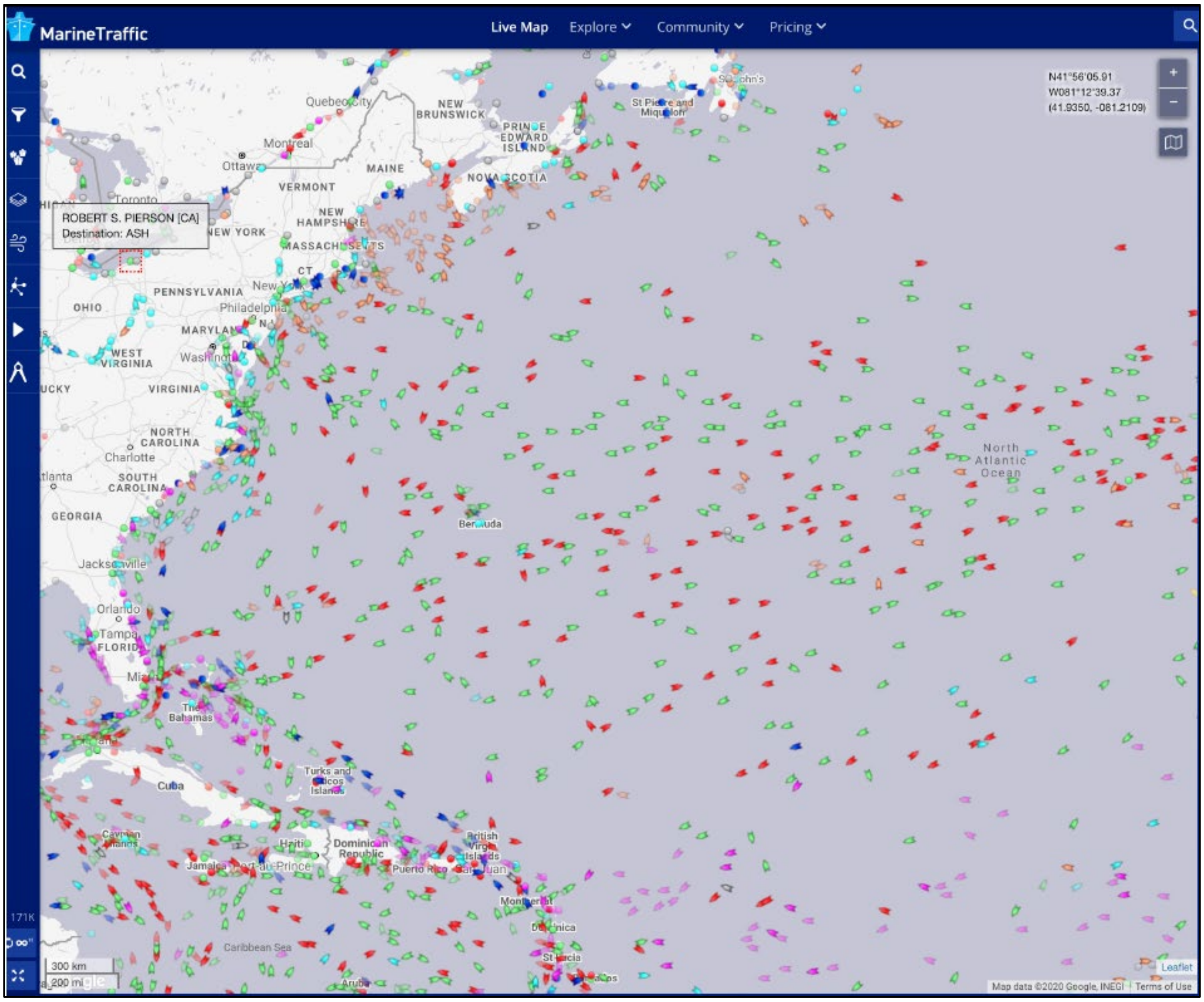


FIGURE 5-5. EXAMPLE OF DAILY VESSEL TRAFFIC OFFSHORE

Source: www.marinetraffic.com, Accessed February 14, 2020 to represent daily vessel traffic.

5.2.4.3 Seabirds

The combination of stressors such as sea-surface temperature changes, habitat modification or loss due to human activities (i.e., urbanization) or large storm events in addition to the effects of climate change can place additional stress on seabird reproduction or foraging. Disturbances from human activities or natural events such as those listed in Table 5-6 can result in a reduction in seabird population health due to mortality, breeding failure or colony abandonment. Disturbance can cause long-term effects to health and survival of affected marine species, and when coupled with changing oceanic conditions and other human-induced stressors, cumulative small impacts can impart large-scale harm (NOS 2019). Wind turbines located offshore would pose a risk of collision for seabirds and may also create barriers to movement resulting in seabird displacement (Michel *et al.* 2007). Eiders and scoters have been documented to avoid offshore wind projects in Denmark and Sweden, and this is assumed to be triggered by visual or auditory cues. Attraction of seabirds to fish and other food sources at wind turbines has also been documented in a small number of studies conducted in Europe, although these potential benefits to

seabirds may be outweighed by an increased risk for collision with wind turbines and structures (Michel *et al.* 2007).

For example, as reported in Webb and Kench (2010), sea-level rise would likely lead to more frequent over-wash of nesting islands by waves, and eventually to complete inundation on many islands and atolls used by breeding seabirds.

Long-term changes to sea-surface temperature and marine chemistry are projected to have severe impacts on marine ecosystems (IPCC 2014). Prey species can be affected by wind and current patterns which alter their distribution and in turn can affect the behavior and movements of predators including seabirds (Behrenfeld *et al.* 2006, Polovina *et al.* 2008). Foraging habitat changes may result in negative consequences on reproductive success for seabirds (Kappes *et al.* 2010). More energy may be expended by seabirds to find food if their foraging habitat becomes degraded or is redistributed to different areas (Suryan *et al.* 2008).

Overall, the contribution of NEFSC research on seabirds is negligible within the context of the past, present and RFFAs listed in Table 5-6.

TABLE 5-6. PAST, PRESENT AND RFFAS POTENTIALLY AFFECTING SEABIRDS

RFFA or Natural Event	Net Effect	Types of Effects
Renewable (Wind) Energy Projects	Moderate Adverse	• Mortality due to strike • Disturbance • Potential entanglement leading to injury or mortality
Commercial Fishing	Minor Adverse	• Potential entanglement leading to injury or mortality
Predation	Minor to Moderate Adverse	• Mortality of eggs and hatchlings due to predation of ground nesting birds from wild and feral animals • Loss of production • Decreased survivorship to adulthood
Marine Debris	Minor to Major Adverse	• Mortality and serious injury • Habitat modification
Seabird Tours	Minor Adverse	• Disturbance
Marine Protected Areas/EFH/Closed Areas	Major Beneficial	• Reduced disturbance • Habitat protection • Reduced mortality • Increased prey availability
Climate Change	Minor to Major Adverse	• Destruction of nesting habitat • Reduced egg production and survivorship • Potential loss of habitat with sea level rising • Potential re-distribution of prey • Potential loss of foraging habitat • Potential redistribution of prey • Loss of nearshore habitats

RFFA or Natural Event	Net Effect	Types of Effects
Hurricanes, Typhoons, Tsunamis	Minor to Moderate Adverse	• Potential loss of roosting and nesting habitats • Loss of nests and production • Reduced survivorship of hatchlings • Potential increased mortality of adults
Construction	Minor Adverse	• Habitat Alteration and Destruction • Disturbance • Potential exposure to contaminants and pollution • Contaminants entering food chains
Vessel Traffic	Minor to Major Adverse	• Mortality • Habitat disruption • Underwater noise • Spills of contaminants

5.2.4.4 Sea Turtles

Sea turtles are threatened by several natural and anthropogenic impacts including but not limited to those listed in Table 5-7. Accumulation of marine debris offshore as well as on beaches poses a threat for entanglement, to foraging and to nesting (NOAA 2014, Duncan *et al.* 2017).The initial developmental stages of all turtle species are spent in the open sea. During this time both juvenile turtles and their buoyant food are drawn into fronts (convergences, rips, and drift lines). The same process accumulates large volumes of marine debris, such as plastics and lost fishing gear, in ocean gyres. Ingestion of plastic debris can block the digestive tract which can cause turtle mortality as well as sub-lethal effects including reduced fitness, and absorption of toxic compounds (Lutcavage *et al.* 1997). The probability of green (*Chelonia mydas*) and leatherback turtles (*Dermochelys coriacea*) ingesting debris has increased significantly in the past several decades, and hawksbill turtles (*Eretmochelys imbricata*) were overall most likely to ingest debris (~47% of individuals with plastic in the gut (Schuyler *et al.* 2014). Plastic was the most commonly ingested debris (Schuyler *et al.* 2014, Duncan *et al.* 2017).

Coastal development continues to remove habitat and increase artificial lighting along the coastline which can alter turtle behavior (NMFS and USFWS 2013a). Sea turtles are also threatened by global climate change (Hawkes *et al.* 2007, Fuentes *et al.* 2011). Sea turtles with high fecundity and low juvenile survival are the most vulnerable to climate change and elevated levels of environmental variability (Cavallo *et al.* 2015). Temperature changes and sea level rise may change ocean currents and the movements of hatchlings, surface-pelagic juveniles, and adults (Hawkes *et al.* 2009, Poloczanska *et al.* 2009, Cavallo *et al.* 2015).

Climate change and sea level rise may have moderate to major impacts on sea turtles depending upon future trophic changes, including changes in the distribution, amount, and types of seagrasses and macroalgal species (Harley *et al.* 2006), thus altering green turtle foraging habitat (Hawkes *et al.* 2009). Sea level rise is likely to reduce the availability and increase the erosion rates of nesting beaches, particularly on low-lying, narrow coastal and island beaches (Fuentes *et al.* 2009, Hawkes *et al.* 2009, Anastacio *et al.* 2014, Pike *et al.* 2015). A Sea Turtle Climate Vulnerability Assessment based on similar assessment for marine mammals by Lettrich *et al.* (2019) is in progress.

Behavioral changes such as changes in foraging or avoidance of migration corridors due to offshore vessel traffic, renewable energy, or coastal construction projects could decrease turtle productivity of survival. Entanglement with moorings, anchors or cables could also injury or kill turtles. The forage-base of green turtles and hawksbill turtles, including invertebrates, seagrasses, and algae, is affected by ocean acidification; however, how these changes would impact the turtles is not clear (Hamann *et al.* 2007, Poloczanska *et al.* 2009). Some beneficial effects may occur due to new offshore structures (i.e., wind turbine foundations) which could attract sea turtle prey. Within the context of global changes and stressors on sea turtles, the contribution of NEFSC research to cumulative effects on sea turtle populations and their habitat is negligible.

TABLE 5-7. PAST, PRESENT AND RFFAS POTENTIALLY AFFECTING SEA TURTLES

RFFA or Natural Event	Net Effect	Types of Effects
Commercial Fishing	Minor to Moderate Adverse	• Potential entanglement leading to injury or mortality
Predation	Minor to Moderate Adverse	• Mortality of eggs and hatchlings due to nest predation from wild and feral animals • Reduced survivorship • Increased mortality • Natural predation of hatchlings in marine environment
Tourism; Ecological Tours	Minor Adverse	• Disturbance • Risk of injury due to ship strike
Ecosystem effects - Global Warming, acidification and coral bleaching	Minor to Major Adverse	• Destruction of nesting habitat • Reduced Productivity and survivorship of all ages • Destruction and alternation of foraging habitats including seagrass beds and reefs • Loss of foraging habitat in coral reefs (hawksbill and green turtles) • Loss of nearshore habitats • Reduced productivity and survivorship
Hurricanes, Typhoons, Tsunamis	Minor to Moderate Adverse	• Disturbance • Habitat alteration or Loss • Loss of nests, production and nesting habitats • Reduced productivity • Mortality or injury
Construction	Minor to Major Adverse or Beneficial	• Disturbance from development • Habitat alteration • Potential exposure to contaminants and pollution • Erosion • Attraction of prey (beneficial)
Marine Protected Areas/EFH/Closed Areas	Minor Beneficial	• Increased prey availability • Increased survival of hatchlings and young • Potential resting and safe harbor for hatchlings and young age-class turtles in open water
Vessel Traffic	Minor to Major Adverse	• Mortality • Habitat disruption • Underwater noise • Spills of contaminants

5.2.4.5 Invertebrates

Table 5-8 summarizes the potential cumulative effects of the RFFAs on invertebrates in the NEFSC research area.

TABLE 5-8. PAST, PRESENT AND RFFAS POTENTIALLY AFFECTING BENTHIC ORGANISMS

RFFA or Natural Event	Net Effect	Types of Effects
Renewable Energy	Minor Adverse	• Disturbance of habitat • Localized mortality of benthic organisms
Undersea Cables	Minor Adverse	• Disturbance of habitat • Localized mortality of benthic organisms
Military Training and Testing	Minor Adverse	• Disturbance of habitat • Potential release of contaminants • Toxicity effects from munitions and other military hardware on the seabed
Marine Protected Areas/EFH/Closed Areas	Major Beneficial	• Habitat protection
Hurricanes, Typhoons, Tsunamis	Minor to Moderate Adverse	• Habitat alteration
Climate Change	Minor Beneficial and Adverse	• Habitat alteration • Alter nutrient flow • Alter temperature regime • Introduced non-native species
Construction	Minor to Moderate Adverse	• Nearshore benthic disturbance • Nearshore habitat alteration
Scientific Research	Minor Beneficial and Adverse	• Gain knowledge of marine life • Benthic disturbance
Vessel Traffic	Minor to Major Adverse	• Mortality • Habitat disruption • Underwater noise • Spills of contaminants

5.2.4.5.1 Climate Change

The climate vulnerability analysis conducted by Hare, Morrison, *et al.* (2016) and described in Section 5.2.1 included 19 species of benthic invertebrates. Three of these species were analyzed in Section 4.3.2.4. The results for these species are summarized in Table 5-9.

TABLE 5-9. CLIMATE VULNERABILITY OF INVERTEBRATE SPECIES ANALYZED IN THIS SPEA

Invertebrate Species	Biological Sensitivity	Climate Exposure	Overall Vulnerability Rank
American lobster	Moderate	High	Moderate
Northern shrimp	High	High	High
Horseshoe crab	High	Very high	Very high

5.2.4.5.2 Other External Factors

Other activities in the action area that may affect benthic organisms include undersea cables and wind farms (see also Sections 5.2.1 and 5.2.3 for additional discussion about impacts of offshore wind). Benthic organisms directly under anchors, anchor chains, cables, or pipes would perish. However, these impacts would occur over a small, localized area for each occurrence, and would not cause wide-spread mortality. Cumulative impacts associated with actions and events listed in Table 5-8 on benthic organisms from research and these past, present and future actions are expected to be negligible.

Dozens of trans-Atlantic undersea cables occupy the seafloor within research areas (see Figure 5-4). These cables disturb the benthic habitat and associated organisms. Impacts to benthic habitat and associated organisms are expected to be minor (Carter 2009). These potential future actions would disturb the benthic environment and likely kill organisms during installation of cables/pipes, though the effect would be localized and the environment should recover.

5.2.5 Social and Economic Environment

Activities external to NEFSC fisheries research that could potentially affect the social and economic environment in the NE LME and offshore areas. These activities may include construction, renewable energy such as wind farms, commercial and recreational fisheries, shipping, coastal development, oil extraction, other scientific research, military operations, climate change, and ocean acidification (see Table 5-10). The potential cumulative effects described in the 2016 PEA (NMFS 2016b) for external factors have not changed due to new activities or events within the NEFSC research areas.

Space-use conflicts are common to all types of offshore activities including commercial fisheries; recreational fishing and other recreational activities; alternative energy facilities including offshore wind shipping traffic; and navigation. Considering the high number of wind energy projects planned along the Atlantic coast (see Figure 5-1), impacts to social and economic resources and proposed wind projects will occur and will be both positive and negative. As described in the 2020 Supplemental EIS for the Vineyard Wind project, social and economic resources (i.e., tourism, recreation, commercial and recreational fishing, etc.) may experience temporary impacts during construction due to higher vessel traffic, construction lighting, cable placement, and noise during pile driving. During operations, minor impacts may result from maintenance dredging in local harbors, operational noise from the turbines, and visual impacts due to turbines being seen from shore or vessels along the coastline (BOEM 2020b). Commercial and for-hire recreational fisheries would likely experience minor impacts from offshore wind projects due to disturbance of the seafloor during cable installation, fishing vessel displacement during construction and operation, noise from pile driving, minor direct and indirect impacts on commercial fish due to displacement, disturbance and avoidance of wind farm areas however, certain species may be attracted to foundation piles (BOEM 2020b). Financial compensation agreements with fishing interests (for example, broadly defined to include vessel owners and operators, vessel crews, shoreside processors, vessel supplier and support services, and other entities that can demonstrate losses directly related to the Vineyard Wind 1 Project) are intended to offset the adverse effects of wind farm installation and operations. In addition, some projects (such as Vineyard Wind) may also create fisheries innovation funds for the purpose of studying the impacts of wind projects on commercial and recreational fisheries in order to develop new technologies that may reduce adverse effects (BOEM 2020b).

Aside from human activities such as vessel traffic and wind projects, cumulative effects of climate change on social and economic resources are also likely. Colburn *et al.* (2016) studied climate change and social vulnerability in fishing dependent communities along the U.S. eastern and gulf coasts. Building on the existing Community Social Vulnerability Indicators (CSVIs), the authors defined new measures of climate change vulnerability for fishing communities. The study found that communities with commercial fishing businesses that have infrastructure near the shore, the impacts from sea level rise can be even greater if the local economy is dependent upon a particular ocean-related industry or ocean species and/or is socially vulnerable. Communities that are highly dependent on fishing were found to more likely be socially vulnerable than other coastal communities. Fishing communities must also consider how reliance on marine species that are vulnerable to the effects of climate change as well as reliance on fisheries with low catch diversity introduce other risks. As ocean characteristics change, fishing patterns may change which will have important implications for individuals, fishing businesses and communities.

TABLE 5-10. PAST, PRESENT AND RFFAS POTENTIALLY AFFECTING SOCIO-ECONOMICS

RFFA or Natural Event	Net Effect	Types of Effects
Construction	Minor to Major Beneficial or Adverse	• Job creation • Support Services • Disruption of current activity
Commercial and Recreational Fishing	Minor to Major Beneficial	• Job creation • Economic inputs • Support Services • Food security
Climate Change	Minor to major Adverse	• Increased storm events • Habitat alteration • Changes in fisheries (positive and negative) • Erosion • Introduced non-native species
Military/USCG	Minor to Moderate Beneficial or Adverse	• Job creation • Support Service • Disruption of current activity
Hurricanes, Typhoons, Tsunamis	Minor to Moderate Adverse	• Increased storm events • Natural disaster declarations • Erosion
Renewable Energy	Minor Adverse	• Disturbance of habitat • Localized mortality of benthic organisms
Oil and Gas	Minor to Major Beneficial or Adverse	• Job creation • Support Services • Disruption of current activity
Undersea Cables	Minor Adverse	• Disturbance of habitat • Localized mortality of benthic organisms
Scientific Research	Minor Beneficial and Adverse	• Gain knowledge of marine life • Benthic disturbance
Tourism/ Recreation	Minor to Major Beneficial	• Job creation • Support Services • Economic inputs

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APPENDIX A
DESCRIPTION OF GEAR AND VESSELS

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1. Trawl Nets

A trawl is a funnel-shaped net towed behind a boat to capture fish. The codend, or ‘bag,’ is the fine-meshed portion of the net most distant from the towing vessel where fish and other organisms larger than the mesh size are retained. In contrast to commercial fishery operations, which generally use larger mesh to capture marketable fish, research trawls often use smaller mesh to enable estimates of the size and age distributions of fish in a particular area. The body of a trawl net is generally constructed of relatively coarse mesh that functions to gather schooling fish so they can be collected in the codend. The opening of the net, called the ‘mouth’, is extended horizontally by large panels of wide mesh called ‘wings.’ The mouth of the net is held open by hydrodynamic force exerted on the trawl doors attached to the wings of the net. As the net is towed through the water, the force of the water spreads the trawl doors horizontally apart.

The trawl net is usually deployed over the stern of the vessel, and attached with two cables, or ‘warps,’ to winches on the deck of the vessel. The cables are played out until the net reaches the fishing depth. Commercial trawl vessels may travel at speeds between two and five knots while towing the net for up to several hours, whereas most NEFSC trawl surveys involve tow speeds from 1.4 to 4.0 knots, and tow durations from 15 to 60 minutes. The speed and duration of the tow depend on the purpose of the trawl, the catch rate, and the target species. At the end of the tow, the net is retrieved and the contents of the codend are emptied onto the deck. For research purposes, the speed and duration of the tow and the characteristics of the net must be standardized to allow meaningful comparisons of data collected at different times and locations. Active acoustic devices incorporated into the research vessel and the trawl gear monitor the position and status of the net, speed of the tow, and other variables important to the research design.

NEFSC research trawling activities use both ‘pelagic’ (surface or mid-water) trawls, which are designed to operate at various depths within the water column, as well as ‘bottom’ trawls, which are designed to capture target species at or near the seafloor (see Figure B-1). Marine mammals can become entangled by trawl gear when swimming with risks differing widely between species. Many species of marine mammals forage and swim at mid-water depths, putting them at risk of being captured or entangled in pelagic trawls. In the Northeast United States, pilot whales and white-sided dolphins are particularly susceptible to being caught in mid-water trawls in nearshore areas. Species that forage on or near the seafloor are at risk of being captured or entangled in bottom trawl netting or tow lines. Humpback whales in the southern Gulf of Maine commonly feed along the seafloor (Ware et al. 2013), making them vulnerable to entanglement in bottom trawl gear. There is also potential for marine mammals to interact with bottom trawl equipment near the surface of the water, as the gear is retrieved from fishing depth and brought aboard the vessel. Historically, the NEFSC has recorded marine mammal interactions with both bottom trawl and pelagic trawl nets (Section 4.2.4).

4-seam, 3-bridle bottom trawl

Several NEFSC research programs utilize a 4-seam, 3-bridle bottom trawl, manufactured using 12 centimeter and 6 cm mesh. The effective mouth opening of the 4-seam, 3-bridle bottom trawl is approximately 70 square meters (14 meter spread x 5 meters high), spread by a pair of trawl doors. The footrope of the trawl is 89 feet in length, and is ballasted with heavy rubber discs or roller gear. The head rope is approximately 79 feet in length and is supported by 60 Nokalon #508, eight inch center hole, orange

trawl floats. For certain research activities, a liner may be sewn into the codend to minimize the loss of small fish.

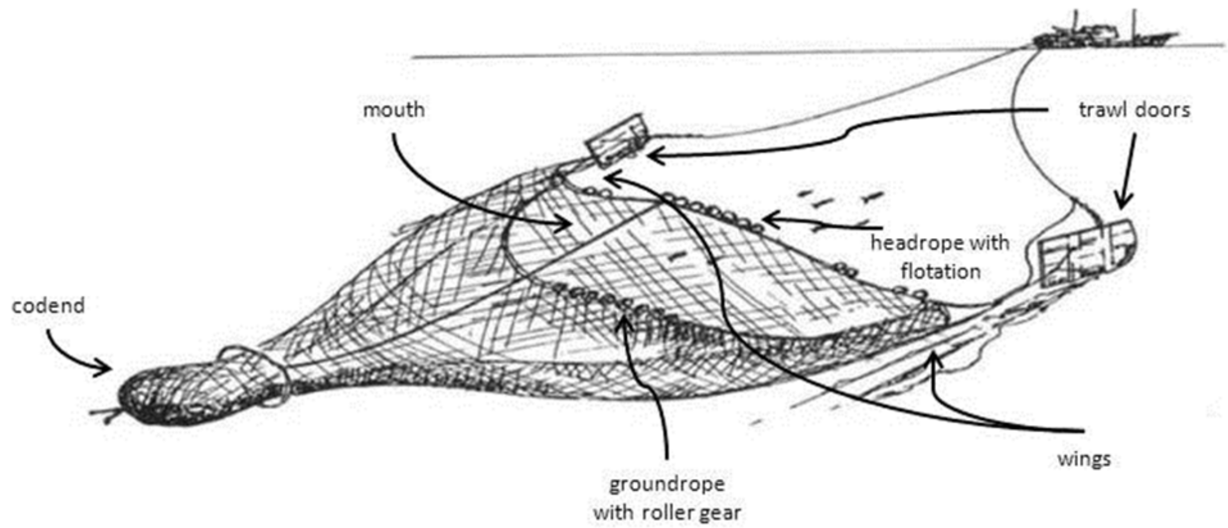

Figure B-1. Bottom trawl illustration

NEFSC uses the 4-seam, 3-bridle bottom trawl for a variety of research programs along the U.S. east coast. The objectives of these cruises include tracking mature animals, determination of juvenile abundance, assessment of habitat distribution, and collection of data on seasonal migrations. The trawl is fished at depth for 15–60 minutes at a time at speeds of 1.5–4 knots.

Midwater Rope Trawl

the High Speed Midwater Rope Trawl (Gourock HSMRT design R202825A) used for the NEFSC's fisheries acoustics surveys employs a four-seam box design with a 174 feet headrope, footrope, and breastlines (see Figure B-2). The mouth opening of the HSMRT is approximately 13.3 meters vertical and 27.5 meters horizontal. Once the net is deployed, changes in the position of the net in the water column are made by increasing or decreasing the speed of the vessel, or by bringing in or letting out trawl wire. Active acoustics are also deployed to monitor the ship and net positions and status. As with bottom trawl nets, protected species may interact with pelagic trawl nets during the deployment and retrieval of the net when the net is at or near the surface of the water. However, because pelagic nets are operated above the seafloor, impacts related to bottom habitat degradation and interactions with bottom-dwelling species are minimal. Because pelagic trawl nets are not designed to contact the seafloor, they do not have bobbins or roller gear, which are often used to protect the foot rope of a 'bottom' trawl net as it is dragged along the bottom.

Figure B-2. Emptying the codend of the High Speed Midwater Rope Trawl
Credit: NEFSC Photo Archives.

Figure B-3. The Isaacs-Kidd Midwater Trawl (IKMT) net
Credit: Joe Warren, Stony Brook University

Other Towed Nets

In addition to the nets described above, NEFSC uses various small, fine-mesh, towed nets designed to sample plankton, small fish, and pelagic invertebrates. The Isaacs-Kidd Midwater Trawl (IKMT), shown in Figure B-3, is used to collect deep water biological specimens larger than those taken by standard plankton nets. The mouth of the net is approximately 1.5 meters wide by 2 meters high, and is attached to a wide, V-shaped, rigid diving vane that keeps the mouth of the net open and maintains the net at depth for extended periods (Yasook et al. 2007). The IKMT is a long, round net approximately 6.5 meters long, with a series of hoops decreasing in size from the mouth of the net to the codend that maintain the shape of the net during towing (Yasook et al. 2007). While most trawls must be towed at speeds of 1 to 2 knots because of the high level of drag exerted by the net in the water, an IKMT can be towed at speeds as high as five knots. The MOCNESS, or Multiple Opening/Closing Net and Environmental Sensing System, uses a stepping motor to sequentially control the opening and closing of the net. The MOCNESS uses underwater and shipboard electronics to control the device. The electronics system continuously monitors the functioning of the nets, frame angle, horizontal velocity, vertical velocity, volume filtered, and selected environmental parameters, such as salinity and temperature. The MOCNESS is used for specialized zooplankton surveys. Similarly, the Tucker trawl is an opening and closing mid-water zooplankton trawl. It is typically equipped with a full suite of instruments, including inside and outside flow meters, CTD, pitch sensor and stepper motor. The Tucker trawl used for NEFSC research surveys uses 333 micron plankton nets with 1.0 meter by 1.4 meter openings. The nets operate at a 45 degree angle during fishing which results in an effective fishing area of 1.0 square meter. The Tucker trawl is designed for deep oblique tows where up to three replicate nets can be sequentially operated by a double release mechanism. There has never been an interaction with a protected species for any of the gear types described in this paragraph during NEFSC research activity.

A beam trawl is a type of bottom trawl that uses a wood or metal beam to hold the net open as it is towed along the sea floor (see Figure B-4). The beam holds open the mouth of the net so that no trawl doors are needed. Beam trawls are generally smaller than other types of bottom trawls. Commercial beam trawls have beam lengths of up to 12 meters, while beam trawls for research purposes typically use beams two to four meters in length.

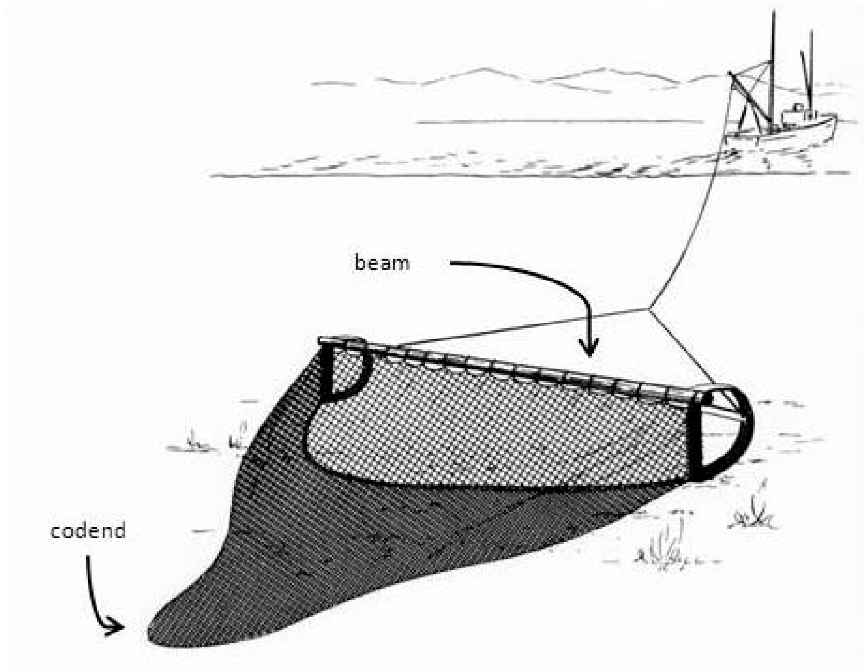

Figure B-4. Beam trawl illustration
Credit: FAO 2001

2. Fyke nets

Fyke nets are bag-shaped nets which are held open by frames or hoops. The fyke nets used in NEFSC survey activities are constructed of successively smaller plastic coated square metal tube frames that are covered with mesh net (0.6 centimeters for small, 1.9 centimeters for large). Two 9.1 meters wings extend from the opening of each fyke at an angle of approximately 30 degrees (Figure B-5). The wings have a weighted footrope and floats on the head-rope and are the same height (either 0.91 meters or 1.83 meters high) and comprised of the same net mesh as the fyke net itself. Each net has two throats tapering to a semi-rigid opening of 12.7 centimeters for the small net and 45.7 centimeters for the larger net. The fish pass through these throats before becoming trapped in the live box. For the large fyke, the final compartment of the net is configured with a rigid framed live box (2 x 2 x 3 meters) at the surface for removal of catch directly from above without having to retrieve the entire net.

A marine mammal excluder device is attached to the outer-most throat of the larger fyke to stop marine mammals from entering the net and becoming trapped. The exclusion device consists of a grate constructed of aluminum bars as shown in Figure B-6. The size of the openings is approximately 14 centimeters, which effectively prohibits marine mammals from entering the net. The dimensions of the grate openings were based on exclusion devices on Penobscot Hydroelectric fishway facilities that are four to six inches and allow for passage of numerous target species including river herring, eels, striped bass, and adult salmon.

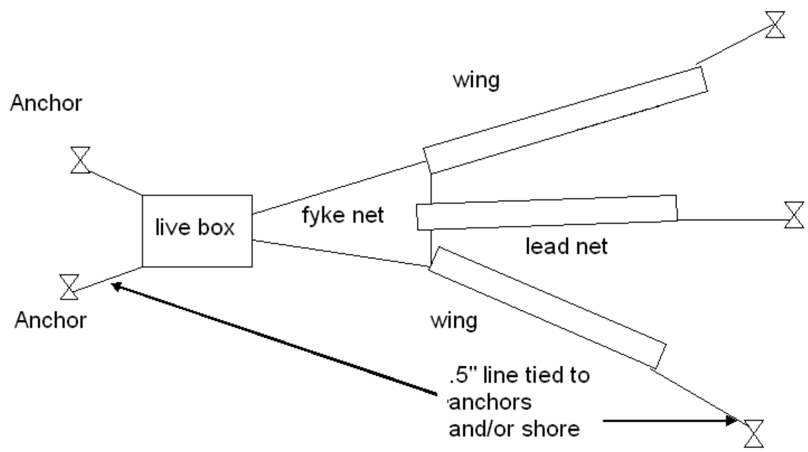

Figure B-5. Sketch of typical fyke net deployment

Orientation may be into, opposite, or perpendicular to flow as appropriate for site.

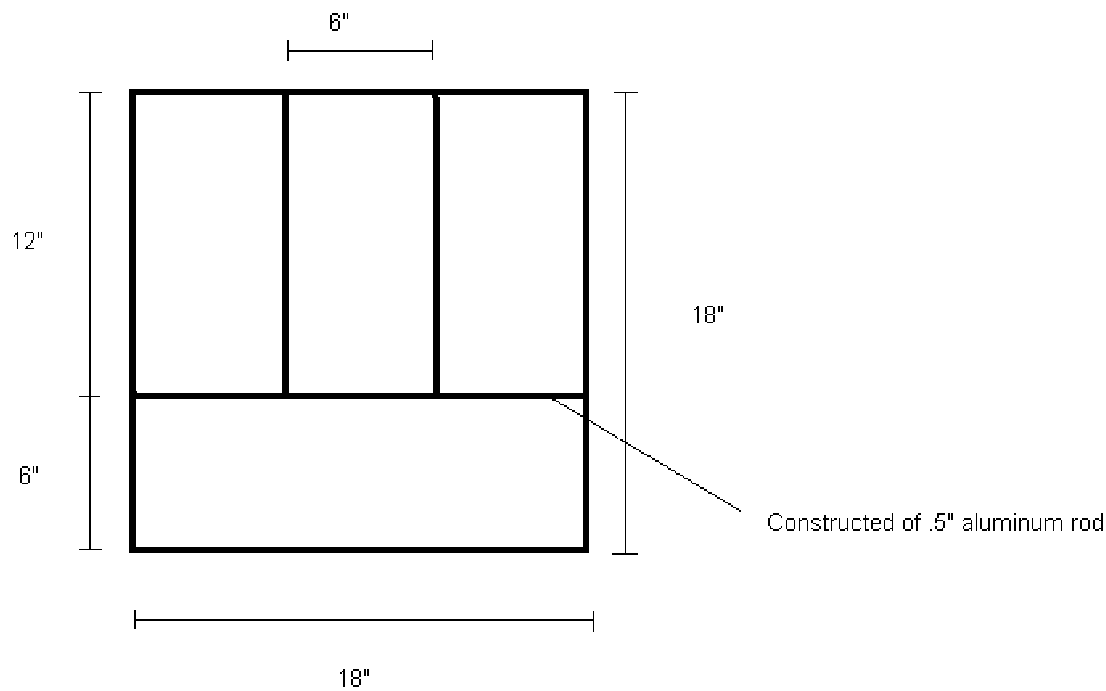

Figure B-6. Sketch of marine mammal excluder device used in the fyke net

The bottom of the grate is parallel to the net bottom as to not exclude small semi-benthic fish.

3. Gillnets

Gillnets consist of vertical netting held in place by floats and weights to selectively target fish of uniform size depending on the netting size (Walden 1996). Typical Gillnets are made of monofilament, multi-monofilament, or multifilament nylon constructed of single, double, or triple netting/paneling of varying mesh sizes, depending on their use and target species (Hovgård and Lassen 2000). A specific mesh size will catch a target species of a limited size range, allowing this gear type to be very selective.

The types of gillnets used in NEFSC survey activities are anchored sinking gillnets. Anchored sinking gillnets are fixed to the ocean floor or at a set distance above (typically in the lower one-third of the water column), held in place by anchors or ballasts with enough weight to counteract the buoyancy of the floats used to hold the net up (Nedelec and Prado 1990). Figure B-7 provides an example of an anchored sinking gillnet. NEFSC survey activities use gillnets that range from 50 to 325 feet in length, 8 to 10 feet in height, with mesh sizes from 6.5 to 12 inches. In some cases, gillnets may be configured in 10-panel strings totaling 3,000 feet long. All gillnets used in NEFSC research use weak links of particular strength and locations on the gear, as specified by the Large Whale Take Reduction Plan, in order to minimize the risk of large whales becoming entangled in the gear. Soak times for long-term surveys are typically 3 hours (Table 2.2-1) but short-term cooperative research projects have used soak times up to 96 hours (Table 2.2-2).

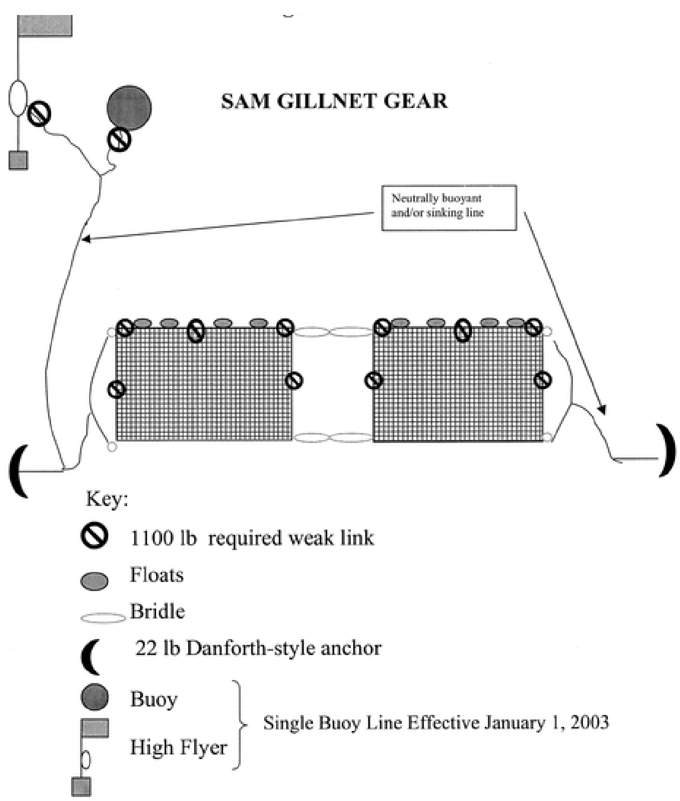

Figure B-7. Anchored sinking gillnet
Credit: 67 FR 1142

4. Pound nets

A pound net is a fixed fishing device that consists of poles or stakes secured into the bottom with netting attached. The structure includes a pound with a netting floor, a heart-shaped enclosure, and a straight wall or leader (Figure B-8). Pound nets are generally set close to shore and the leader is set perpendicular to the shore to guide migrating fish into the pound. The leader is a wall of mesh webbing that extends from the sea floor to approximately the sea surface and may be up to several hundred meters in length (Silva et al. 2011).

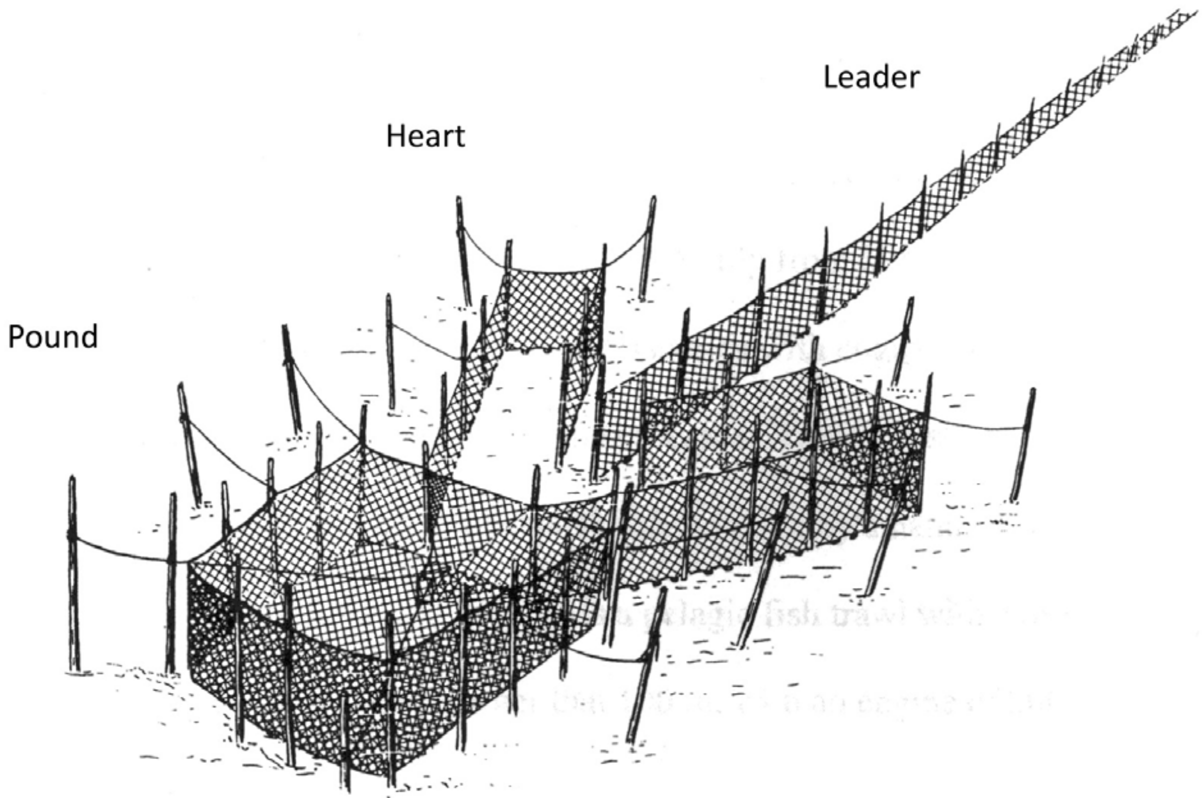

Figure B-8. Pound net diagram

Credit: Silva et al. 2011

Fish swimming laterally along the shoreline encounter the leader and generally turn towards deeper water to circumvent the obstruction (DeAlteris *et al.* 2005). The heart and pound portions of the net, located at the deep end of the leader, direct and trap the fish so they cannot escape. The pound is usually a rectangular enclosure 6 to 13 meters long constructed of small mesh (DeAlteris *et al.* 2005). Pound nets are relatively non-selective, and are used to capture several species of live fish (DeAlteris et al. 2005). NEFSC has previously conducted research focused on the relationships between pound net leader design and bycatch of sea turtles and other protected species (DeAlteris *et al.* 2005; Silva *et al.* 2011).

5. Longline

Longline vessels fish with baited hooks attached to a mainline or ‘groundline’(see Figure B-9). The length of the longline and the number of hooks depend on the species targeted, the size of the vessel, and the

purpose of the fishing activity. Commercial longlines can be over 62 miles long and can have thousands of hooks attached, however longlines used for research purposes are usually shorter. The longline gear used for NEFSC research purposes typically uses 100-400 hooks attached to a line 2 to 10 miles in length, except for the small-scale Cooperative Atlantic States Shark Pupping and Nursery (COASTSPAN) surveys that typically use 25-50 hooks attached to a 1,000 feet mainline. Hooks are attached to the longline by another thinner line called a 'gangion' The length of the gangion and the distance between gangions depends on the purpose of the fishing activity.

Depending on the fishery, longline gear can be deployed on the seafloor (bottom longline), in which case weights are attached to the mainline, or longline gear can be deployed near the surface of the water (pelagic longline), in which case buoys are attached to the mainline to provide flotation and keep the baited hooks suspended in the water. Radar reflectors, radio transmitters, and light sources are often used to help fishers determine the location of the longline gear prior to retrieval. Light sources may also be attached to the gangions to attract target species to the gear. Because pelagic longline gear is not anchored to the seafloor, it floats freely in the water, and may drift considerable distances between the time of deployment and the time of retrieval.

'Yankee' swordfish-style pelagic longline gear consists of 5/16 inches tarred nylon mainline, with 24-33 foot gangions composed of 13 feet of 3/16 inches nylon, 7 feet of 3/32 inches stainless steel leader, and a #40 Japanese tuna hook. For research purposes, the hooks are baited with whole Atlantic mackerel, and attached at 170 feet intervals. Floats are attached at five hook intervals on 40 feet float lines. Flag buoys, or 'high flyers,' are located at each end of the gear.

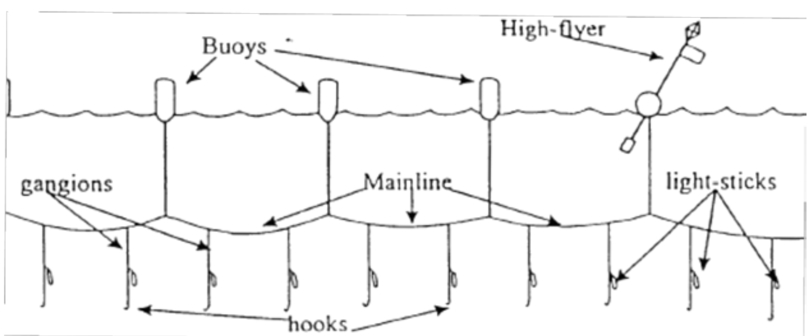

Figure B-9. Pelagic longline gear diagram

'Florida' commercial-style bottom longline gear consists of 940-pound test monofilament mainline with 12 feet gangions made of 730-pound test monofilament with a longline clip at one end and a 3/0 shark hook at the other. Hooks are baited with chunks of spiny dogfish and are attached to the mainline at roughly 60 feet intervals. Five-pound weights are attached at 15 hook intervals, and 15-pound weights and small buoys are attached at 50 hook intervals. To ensure that the gear fishes on the bottom, 20-pound weights are placed at the beginning and end of the mainline after a length of line two to three times the water depth is deployed. A 20 feet flag buoy ('high flyer') equipped with radar reflectors and flashing lights is attached to each end of the mainline. The flag buoys used for bottom longline gear use long buoy lines to allow the weighted groundline to rest on the seafloor while the attached buoys float on the surface to enable retrieval of the gear.

The small-scale COASTSPAN surveys use two types of anchored bottom longline gear: one for targeting small juvenile sharks and the other targets large juveniles and adult sharks. The juvenile gear consists of 1000 feet of 1/4 inches braided nylon mainline with at least 200 feet of additional line on each side for scope, and 50 gangions attached at 20 feet intervals, comprised of 12/0 Mustad circle hooks with barbs depressed, 20 inches 1/16 stainless cable, and 40 inches of 1/4 inch braided nylon line with 4/0 longline snaps. The large juvenile/adult survey uses the same type and length of mainline as the juvenile gear with 25 gangions attached at 40 feet intervals, comprised of 16/0 Mustad circle hooks with barbs depressed, 20 inches of 3/32 stainless cable, and 80 inches of 3 mm clear monofilament with 4/0 longline snaps. Previously frozen Atlantic mackerel or herring are purchased and used as bait for both juvenile and large juvenile/adult shark longline gear.

The time between deployment and retrieval of the longline gear is the ‘soak time.’ Soak time is an important parameter for calculating fishing effort. For commercial fisheries the goal is to optimize the soak time to maximize catch of the target species while minimizing the bycatch rate, and minimizing damage to target species caught on the hooks that may result from predation by sharks or other predators. Soak time can also be an important factor for controlling longline interactions with protected species. Marine mammals, turtles, and other protected species may be attracted to bait, or to fish caught on the longline hooks. Protected species may become caught on longline hooks or entangled in the longline while attempting to feed on the catch before the longline is retrieved.

Birds may be attracted to the baited longline hooks, particularly while the longline gear is being deployed from the vessel. Birds may get caught on the hooks, or entangled in the gangions while trying to feed on the bait. Birds may also interact with longline gear as the gear is retrieved.

6. Hydraulic dredge

Hydraulic dredges are used to harvest Atlantic Surfclams (*Spisula solidissima*) and Ocean Quahogs (*Arctica islandica*) using pressurized water jets to wash clams out of the seafloor. The water jets penetrate the sediment in front of the dredge and help to propel the dredge forward. A blade on the front of the dredge then lifts the clams that have been separated from the sediment, and guides them into the body, or “cage,” of the dredge. The hydraulic dredges used for the NEFSC surfclam/ocean quahog survey employ a 12.5 feet blade and are towed at a rate of 1.5 knots. During survey tows, the dredge is deployed at depth for a duration of five minutes. As they are towed along the seafloor, hydraulic dredges may interact with sea turtles, and considerable effort has been made to develop devices and modify dredge design in order to minimize interactions between hydraulic dredges and sea turtles. Turtle mats and excluder devices (described below) may reduce the severity of some turtle interactions by preventing turtles from entering the dredge (Murray 2011).

7. New Bedford-type dredge

The New Bedford-type dredge is primarily used to harvest sea scallops in the Georges Bank and Mid-Atlantic scallop fisheries. The forward edge of the New Bedford-type dredge uses a cutting bar to create turbulence that drives scallops from the sediment into the bag of the dredge (see Figure B-10). The bag is made of metal rings and drags on the seafloor. Towing times for commercial scallop dredges are highly variable, depending on the size of the bag and the density of sea scallops at the fishing location. New

Bedford-type dredges may interact with sea turtles, and NEFSC surveys use a turtle mat to minimize the impacts of dredge sampling on turtles.

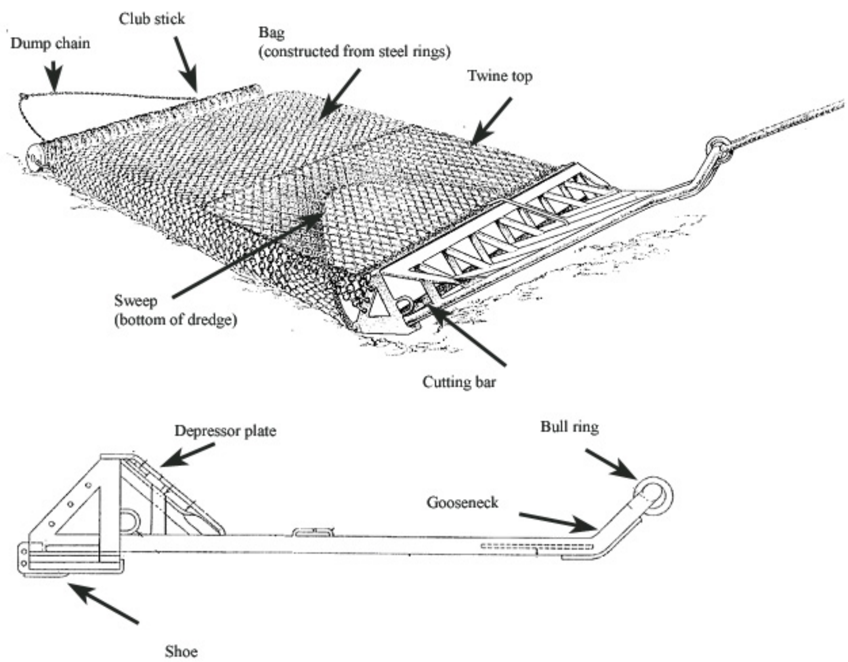

Figure B-10. Standard New Bedford sea scallop dredge

In response to the observed capture of sea turtles in scallop dredge gear, including serious injuries and mortality as a result of capture, NMFS proposed a modification to scallop dredge gear (70 FR 30660, May 27, 2005). The rule, finalized as proposed (71 FR 50361, August 25, 2006), required federally permitted scallop vessels fishing with dredge gear in Mid-Atlantic waters south of 41 °9'N from the shoreline to the outer boundary of the EEZ between May and November to modify their gear by adding an arrangement of horizontal and vertical chains (hereafter referred to as a "chain mat" or "turtle mat") between the sweep and the cutting bar (see Figure B-11). The requirement was subsequently modified by emergency rule on November 15, 2006 (71 FR 66466), and by a final rule published on April 8, 2008 (73 FR 18984). On May 5, 2009, NMFS proposed additional minor modifications to the regulations on how chain mats are configured (74 FR 20667). Chain mats consist of vertical and horizontal chains hung between the sweep and cutting bar and are intended to reduce the severity of some turtle interactions by preventing turtles from entering the dredge bag (Murray 2011). Monitoring the effectiveness of chain mats is difficult because interactions could still be occurring, but the chain mat prevents the turtle from being captured and observed (Murray 2011). However, chain mats are not expected to reduce the overall number of sea turtle interactions with scallop dredge gear.

Figure B-11. Turtle chain mat on traditional scallop dredge frame

Additional design modifications to a traditional New Bedford style scallop dredge were evaluated by NEFSC in cooperation with the Coonamesset Farm Foundation to prevent loggerhead sea turtles from snagging on top of the dredge frame or becoming trapped under the dredge bale, while maintaining efficiency for dredging sea scallops (Smolowitz *et al.* 2008). The final design, the Coonamesset Farm turtle excluder dredge (see Figure B-12), proved effective at guiding turtles over the top of the dredge by eliminating most of the bale bars and forming a ramp with a forward positioned cutting bar and closely spaced struts leading back at a forty-five degree angle (Smolowitz *et al.* 2008).

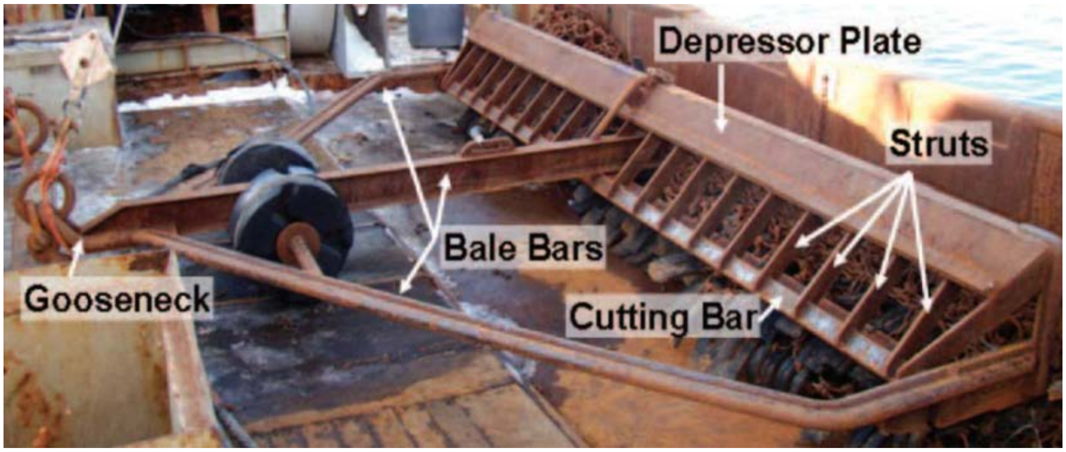

Figure B-12. Coonamessett Farm turtle deflector dredge

8. Naturalist dredge

The Naturalist dredge, shown in Figure B-13, is primarily used to obtain samples of megafaunal species, such as oysters, crabs, mussels and whelks. The Naturalist dredge is typically small (1 meter wide) and

towed along the seafloor over a relatively short distance (30 to 200 feet) in order avoid overfilling the dredge and losing part of the sample. All megafauna from the dredge samples are picked out by hand and processed on deck after retrieval of the dredge. Due to the small size of the Naturalist dredge and the limited periods of time over which it is deployed, interactions with protected species are expected to be minimal. However, dredges do disturb bottom habitats, and may potentially interact with sea turtles.

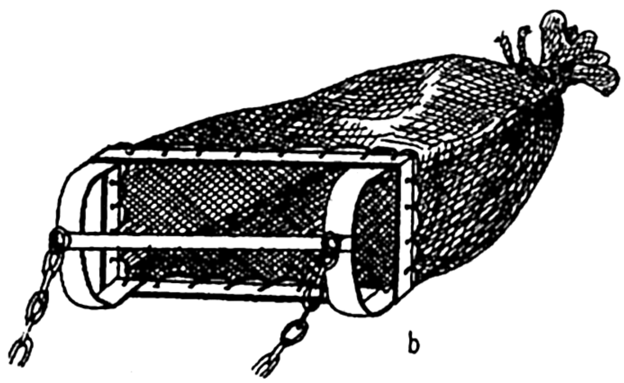

Figure B-13. Naturalist dredge

9. Fish / Lobster Pots

Several NEFSC and cooperative research surveys use fish or lobster pots to selectively capture species for research, tagging studies, and sample collection. Fish pots can be designed to select for particular species by configuring the entrances, mesh, and escape tunnels (or "vents") to allow retention of the target species, while excluding larger animals, and allowing smaller animals to escape from the pot before retrieval. In many instances, animals remain alive in the pot until it is pulled, making pots a preferred method for collecting some species for tagging or mark / recapture studies.

The NEFSC research set aside program targeting black sea bass in southern New England (SNE) and Mid-Atlantic waters uses unvented pots 43½ inches long, 23 inches wide, and 16 inches high made with 1½ inches by 1½ inches coated wire mesh, a single mesh entry head, and a single mesh inverted parlor nozzle (see Figure B-14).

Figure B-14. Retrieval of a pot targeting black sea bass

Other NEFSC research activities targeting various finfish and shellfish species use different pot configurations, depending on the species of interest. Figure B-15 shows examples of different types of pots.

Figure B-15. Examples of pot equipment

10. Rotary Screw Trap

Rotary screw traps (RSTs) enable live capture of smolts emigrating from several coastal rivers, including the Narraguagus, Penobscot, Pleasant, and Sheepscot Rivers. RSTs are used to estimate smolt populations, enumerate and sample smolts (and other co-occurring species), and to better understand factors that limit smolt production and migration success. Figure B-16 shows a RST that was used on the Sheepscot River to capture Atlantic salmon smolts. RSTs are also platforms for telemetry studies that provide valuable data on smolt behavior and migratory success. RSTs are positioned in the water channels to maximize fish capture. Fish enter the trap through the large end of a revolving and half-submerged screen cone suspended between two pontoons. The NEFSC uses RSTs with different size openings (4 ft, 5 ft, and 8 ft models). As

the river current turns the cone, the fish are guided downstream into a live car, where they are held in river water until retrieved for sampling. Traps are tended daily, so fish spend as little time as possible in the live car. As smolts tend to move downstream at night, they often confined for less than 12 hours.

RSTs require adequate water depth and current to rotate the cone for most effective “fishing.” Although RSTs can be used in high flow conditions, they sometimes become jammed with debris. River conditions are monitored closely to prevent fish injury. RSTs are equipped with a hubodometer that records the number of revolutions of the cone, allowing for an estimation of catch per unit of effort.

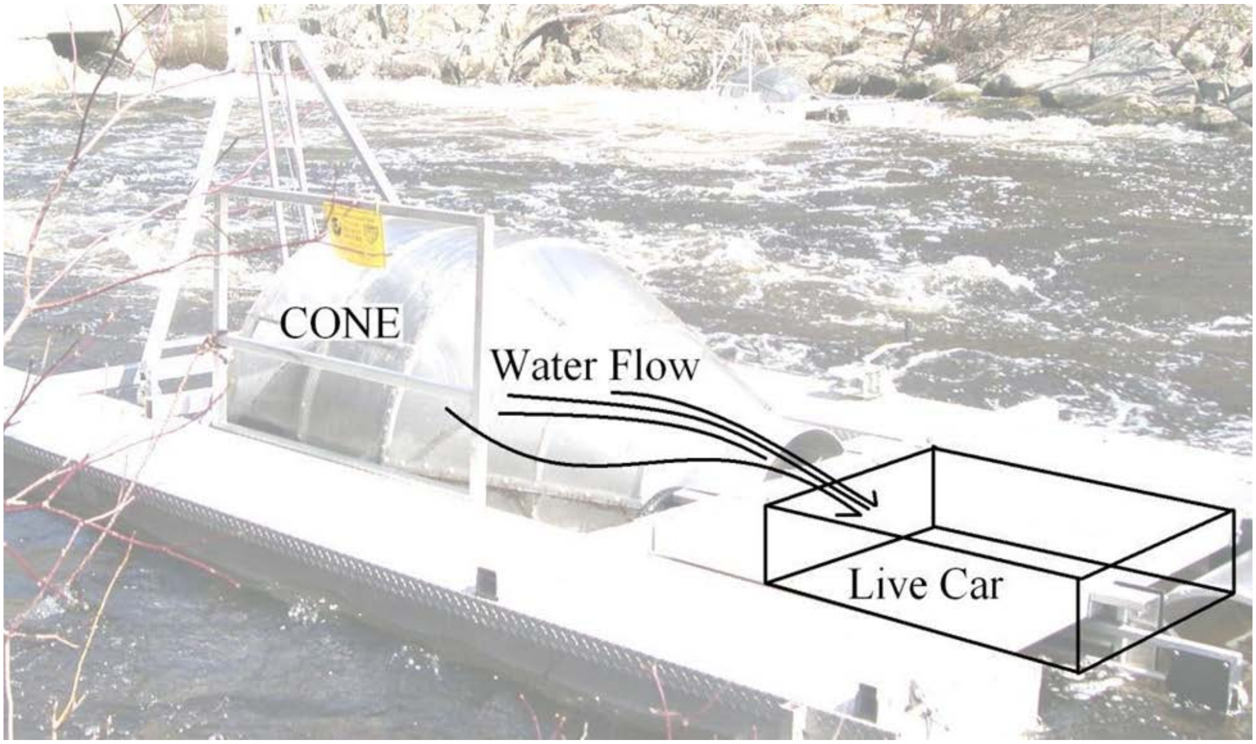

Figure B-16. Rotary screw trap
Credit: NOAA archives

11. Various plankton nets (Bongo Nets)

NEFSC research activities include the use of several plankton sampling nets that employ very small mesh to sample plankton and fish eggs from various parts of the water column. Plankton sampling nets usually consist of fine mesh attached to a weighted frame. The frame spreads the mouth of the net to cover a known surface area. The Bongo nets used for NEFSC surveys typically have openings 61 centimeters in diameter and employ either 333 micrometer or 505 micrometer mesh. The nets are 3 meters in length with a 1.5 meters cylindrical section coupled to a 1.5 meters conical portion that tapers to a detachable codend constructed of 333 micrometers or 0.505 micrometer nylon mesh (Figure B-17).

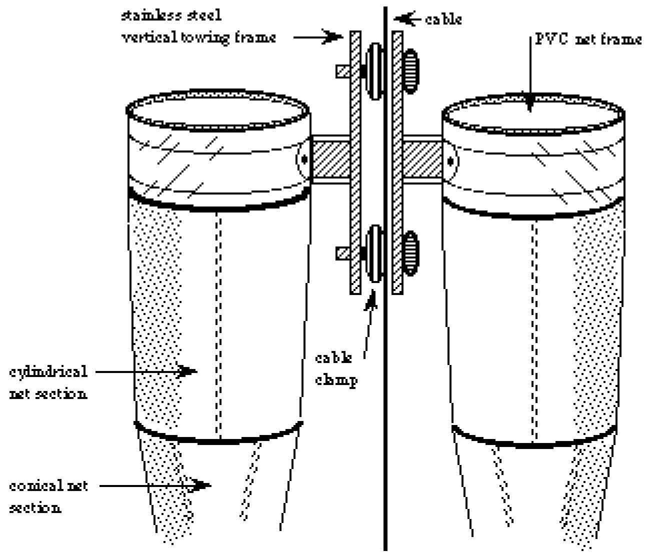

Figure B-17. Bongo net diagram

Credit: Aquatic Research Instruments (2011)

The bongo nets are towed through the water at an oblique angle to sample plankton over a range of depths. During each plankton tow, the bongo nets are deployed to a depth of approximately 210 meters and are then retrieved at a controlled rate so that the volume of water sampled is uniform across the range of depths. In shallow areas, sampling protocol is adjusted to prevent contact between the bongo nets and the seafloor. A collecting bucket, attached to the codend of the net, is used to contain the plankton sample. When the net is retrieved, the collecting bucket can be detached and easily transported to a laboratory. Some bongo nets can be opened and closed using remote control to enable the collection of samples from particular depth ranges. A group of depth-specific bongo net samples can be used to establish the vertical distribution of zooplankton species in the water column at a site. Bongo nets are generally used to collect zooplankton for research purposes, and are not used for commercial harvest.

12. Van Veen sediment grab sampler

Sediment grab samplers are used to collect sediments and assess populations of benthic fauna from the seafloor. The Van Veen grab sampler is comprised of a hinged pair of scoops that can be deployed over the side of the vessel and lowered to the seafloor on a cable (see Figure B-18). The scoops are approximately 31 centimeters wide to allow sampling of a 0.1 square meter area of the seafloor. Sharp cutting edges on the bottoms of the scoops enable them to penetrate up to about 40 centimeters into the sediment. The grab sampler may be galvanized, stainless steel, or Teflon-coated.

Prior to deployment, the sampler is cocked with the safety key in place. The sampler is then deployed over the side of the vessel, the safety key is removed, and the sampler is slowly lowered to the bottom. After bottom contact has been made (indicated by slack in the cable), the tension on the cable is slowly increased, causing the scoops to close. Once the sampler is back on board, the top doors are opened for inspection of the sediment sample (Stubbs et al. 1987).

The Van Veen sediment grab sampler is designed to collect sediments and invertebrates from the seafloor and potential interactions with marine mammals, turtles, or birds are believed to be negligible.

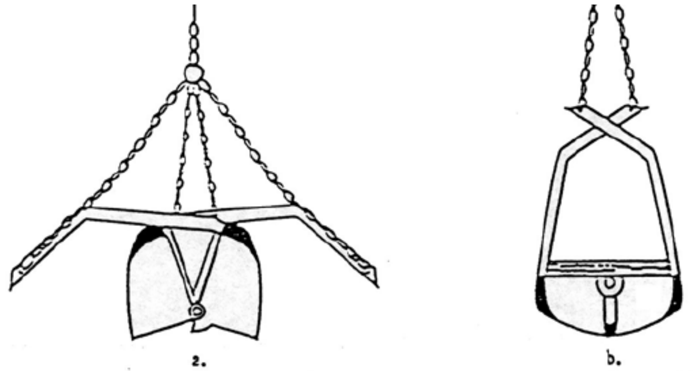

Figure B-18. Van Veen grab sampler: a) cocked position b) closed position
Credit: modified from Stubbs et al. (1987)

13. ADCP

An Acoustic Doppler Current Profiler, or ADCP, is a type of sonar used for measuring water current velocities simultaneously at a range of depths. In the past, current depth profile measurements required the use of long strings of current meters. ADCP enables measurements of current velocities across an entire water column, replacing the long strings of current meters. An ADCP anchored to the seafloor can measure current speed not just at the bottom, but also at equal intervals all the way up to the surface (WHOI 2011). An ADCP instrument can also be mounted to a mooring, or to the bottom of a boat.

The ADCP measures water currents with sound, using the Doppler Effect. A sound wave has a higher frequency when it moves towards the sensor (blue shift) than when it moves away (red shift). The ADCP works by transmitting "pings" of sound at a constant frequency into the water. As the sound waves travel, they ricochet off particles suspended in the moving water, and reflect back to the instrument (WHOI 2011). Due to the Doppler Effect, sound waves bounced back from a particle moving away from the profiler have a slightly lowered frequency when they return. Particles moving toward the instrument send back higher frequency waves. The difference in frequency between the waves the profiler sends out and the waves it receives is called the Doppler shift. The instrument uses this shift to calculate how fast the particle and the water around it are moving. Sound waves that hit particles far from the profiler take longer to come back than waves that strike close by. By measuring the time it takes for the waves to return to the sensor, and the Doppler shift, the profiler can measure current speed at many different depths with each series of pings (WHOI 2011).

ADCPs operate at frequencies between 75 and 600 kilohertz. High frequency pings yield more precise data, but low frequency pings travel farther in the water. Thus, a compromise must be made between the distance that the profiler can measure and the precision of the measurements (WHOI 2011).

ADCPs that are bottom-mounted need an anchor to keep them on the bottom, batteries, and a data logger. Vessel-mounted instruments need a vessel with power, a shipboard computer to receive the data, and a GPS navigation system so the ship's movements can be subtracted from the current velocity data (WHOI 2011).

14. CTD profiler

'CTD' is an acronym for Conductivity, Temperature, and Depth. A CTD profiler measures these parameters, and is the primary research tool for determining chemical and physical properties of seawater. A shipboard CTD is made up of a set of small probes attached to a large (1 to 2 meters in diameter) metal rosette wheel (see Figure B-19). The rosette is lowered through the water column on a cable, and CTD data are observed in real time via a conducting cable connecting the CTD to a computer on the ship. The rosette also holds a series of sampling bottles that can be triggered to close at different depths in order to collect a suite of water samples that can be used to determine additional properties of the water over the depth of the CTD cast. A standard CTD cast, depending on water depth, requires 2 to 5 hours to complete (WHOI 2011). The data from a suite of samples collected at different depths are often called a depth profile, and are plotted with the value of the variable of interest on the x-axis and the water depth on the y-axis. Depth profiles for different variables can be compared in order to glean information about physical, chemical, and biological processes occurring in the water column.

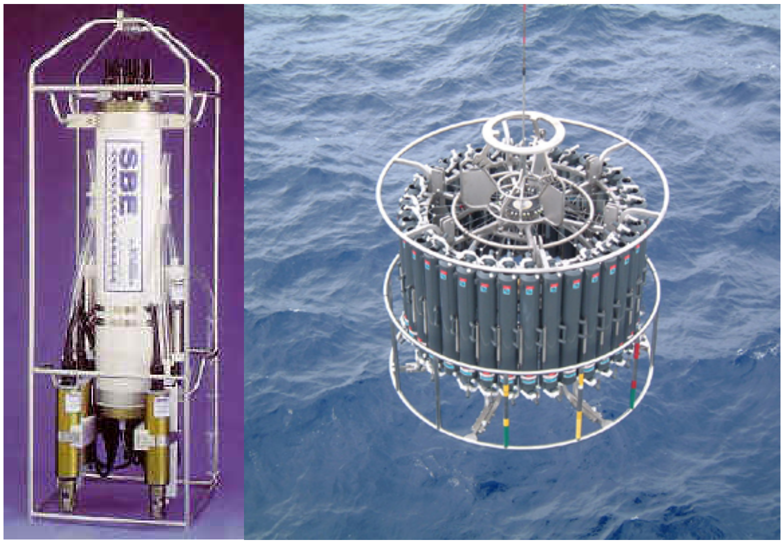

Figure B-19. Sea-Bird 911*plus* CTD profiler and deployment on a sampling rosette
Credit: Sea-Bird Electronics, Bellevue, WA

Conductivity is measured as a proxy for salinity, or the concentration of salts dissolved in the seawater. Salinity is expressed in 'practical salinity units' (psu) which represent the sum of the concentrations of several different ions. Salinity is calculated from measurements of conductivity. Salinity influences the types of organisms that live in a body of water, as well as physical properties of the water. For instance, salinity influences the density and freezing point of seawater.

Temperature is generally measured using a high-sensitivity thermistor protected inside a thin walled stainless steel tube. The resistance across the thermistor is measured as the CTD profiler is lowered through the water column to give a continuous profile of the water temperature at all water depths.

The depth of the CTD sensor array is continuously monitored using a very sensitive electronic pressure sensor. Salinity, temperature, and depth data measured by the CTD instrument are essential for characterization of seawater properties.

15. Still and video camera images taken from an ROV and towed camera array (HabCam)

The NEFSC maintains and deploys remotely operated vehicles (ROVs)(See Figure B-20). The ROVs are used to quantify fish and shellfish, photograph fish for identification, and provide information for habitat-type classification studies. Still and video camera images are also used to monitor the operation of bycatch reduction devices. Precise geo-referenced data from ROV platforms also enables SCUBA divers to use bottom time more effectively for collection of brood stock and other specimens.

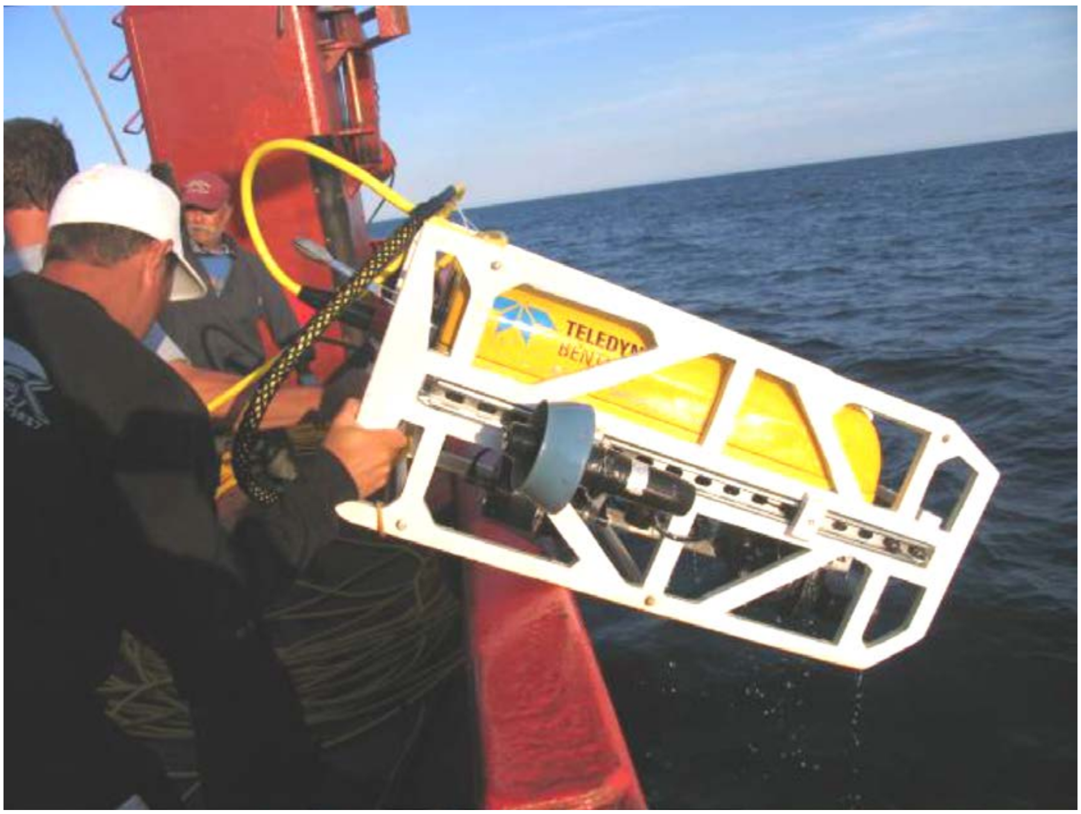

Figure B-20. ROV being deployed from scallop vessel

The Seabed Observation and Sampling System (SEABOSS) was designed for rapid, inexpensive, and effective collection of seabed images and sediment samples in coastal/inner-continental shelf regions. The observations from video and still cameras, along with sediments collected in the sampler, are used in conjunction geophysical mapping surveys to provide more comprehensive interpretations of seabed character.

The SEABOSS incorporates two video cameras, a still camera, a depth sensor, light sources, and a modified Van Veen sediment sampler (see Figure B-21). These components are attached to a stainless steel frame that is deployed through an A-frame, using a power winch, as the SEABOSS weighs 300 pounds. The SEABOSS frame has both a stabilizing fin capable of orienting the system while it drifts, and base plates that prevent over-penetration when the system rests on the sea floor. Undisturbed samples are taken with the modified Van Veen sampler. The system begins imaging the sea floor with a 35-millimeter camera

before touching bottom, at 30 inches height above bottom. Scale, time, and exposure number are annotated on each image. These images are later scanned into a digital format. A downward-looking video camera overlaps the field of view of the still camera. The second video camera is mounted in a forward-looking orientation, providing an oblique sea floor view and enables a shipboard operator to monitor for proper tow-depth and for obstacles to the SEABOSS while operations are underway. (Blackwood *et al.* 2000).

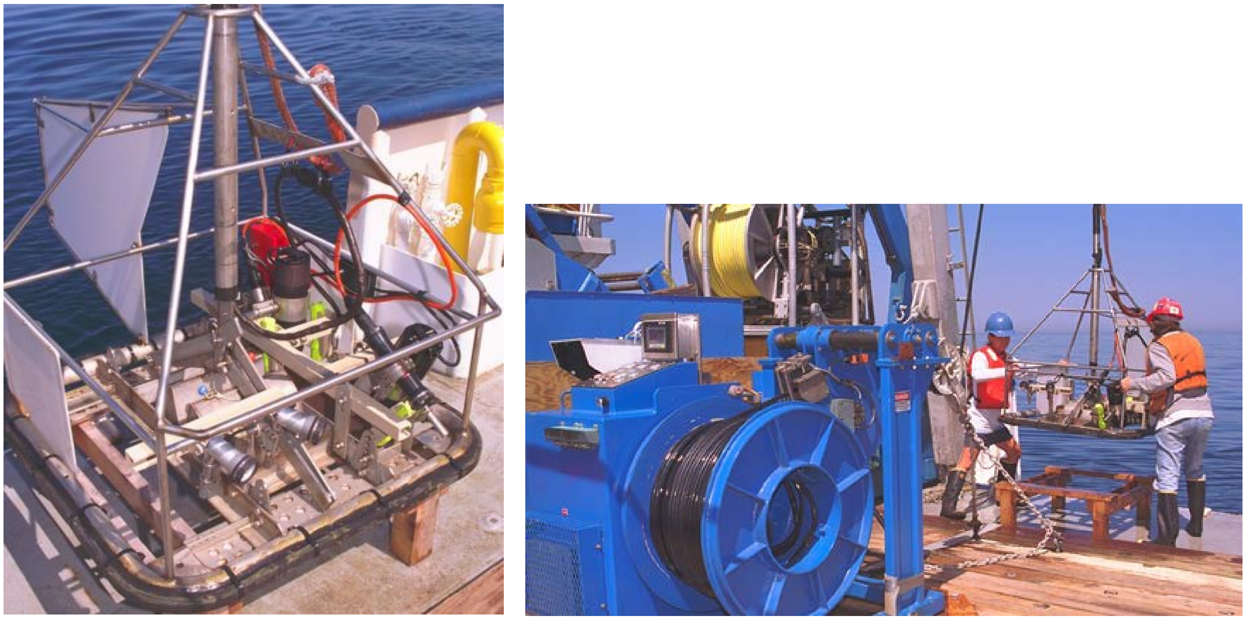

Figure B-21. The SEABOSS benthic observation system

The NEFSC utilizes a downward facing towed stereo-optic camera array (HabCam) to annually assess the sea scallop resource along the eastern continental shelf (see Figure B-22). The stereo images are collected in realtime using an armored towing fiber optic cable. The array is actively flown/towed about 1 – 2 meters above the sea floor. The camera system is capable of being deployed 24 hours a day and covers about 100 nm during that time.

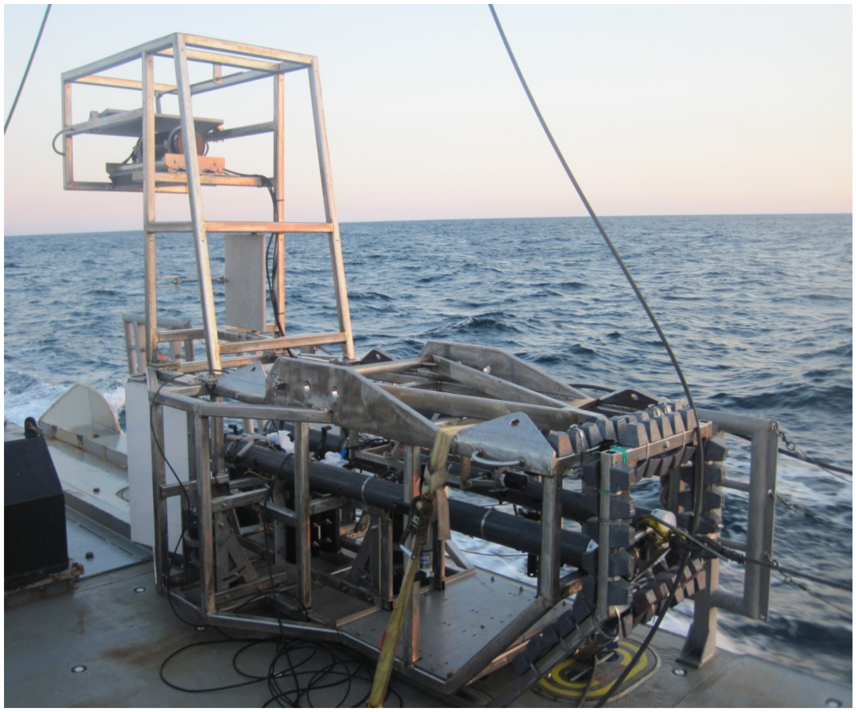

Figure B-22. The HabCam Stereo-Optic Towed Camera Array

16. Active Acoustic Sources used in NEFSC Fisheries Surveys

A wide range of active acoustic sources are used in NEFSC fisheries surveys for remotely sensing bathymetric, oceanographic, and biological features of the environment. Most of these sources involve relatively high frequency, directional, and brief repeated signals tuned to provide sufficient focus and resolution on specific objects. Important characteristics of the nine predominant NEFSC acoustic sources are provided below in Tables A-1, followed by descriptions of some of the primary sources.

Table B-1 Output characteristics for the seven predominant NEFSC active acoustic sources.

Active Acoustic System (product name and #)	Operating frequencies (kHz)	Maximum source level (dB re 1 μPa at 1 m)	Single ping duration	Nominal beam width (degrees)
Simrad EK60 Narrow Beam Scientific Echo Sounder	18, 38, 70, 120, 200, & 333	224	1 millisecond	11° at 18 kHz; 7° at 38, 120, 200 & 333 kHz
Simrad ME70 Multi-Beam Echo Sounder	70-120	205	150 microsecond	140°
Teledyne RD Instruments Acoustic Doppler Current Profiler (ADCP), Ocean Surveyor	75	224		30°
Simrad SX90 Narrow Beam Sonar (conservative assumption--pointed horizontally)	20-30	219		7°
Raymarine SS260 (DSM300 sounder)	50, 200	217		19° at 50 kHz; 6° at 200 kHz
NetMind	30, 200	190		50°
Simrad EQ50	50, 200	210		16° at 50 kHz; 7° at 200 kHz

17. Multi-frequency Narrow Beam Scientific Echo Sounders (Simrad EK60 - 18, 38, 70, 120, 200, 333 kilohertz)

Similar to multibeam echosounders, multi-frequency split-beam sensors are deployed from NOAA survey vessels to acoustically map the distributions and estimate the abundances and biomasses of many types of fish; characterize their biotic and abiotic environments; investigate ecological linkages; and gather information about their schooling behavior, migration patterns, and avoidance reactions to the survey vessel. The use of multiple frequencies allows coverage of a broad range of marine acoustic survey activity, ranging from studies of small plankton to large fish schools in a variety of environments from shallow coastal waters to deep ocean basins. Simultaneous use of several discrete echosounder frequencies facilitates accurate estimates of the size of individual fish, and can also be used for species identification based on differences in frequency-dependent acoustic backscattering between species. The NEFSC uses devices that transmit and receive at six frequencies ranging from 18 to 333 kilohertz.

18. Single Frequency Omnidirectional Sonars (Simrad SX-90)

Low frequency, high-resolution, long range fishery sonars including the SX-90 operate with user selectable frequencies between 20 and 30 kilohertz providing longer range and prevent interference from other vessels. These sources provide an omnidirectional imaging around the source with three different vertical beamwidths, single or dual vertical view and 180° tiltable vertical views are available. At 30 kilohertz operating frequency, the vertical beamwidth is less than seven degrees. This beam can be electronically tilted from +10 to -80 degrees, which results in differential transmitting beam patterns. The cylindrical

multi-element transducer allows the omnidirectional sonar beam to be electronically tilted down to -60 degrees, allowing automatic tracking of schools of fish within the whole water volume around the vessel. The signal processing and beamforming is performed in a fast digital signal processing system using the full dynamic range of the signals.

19. Multi-beam echosounder (Simrad ME70)

Multibeam echosounders and sonars work by transmitting acoustic pulses into the water then measuring the time required for the pulses to reflect and return to the receiver and the angle of the reflected signal (see Figure B-23). The depth and position of the reflecting surface can be determined from this information, provided that the speed of sound in water can be accurately calculated for the entire signal path.

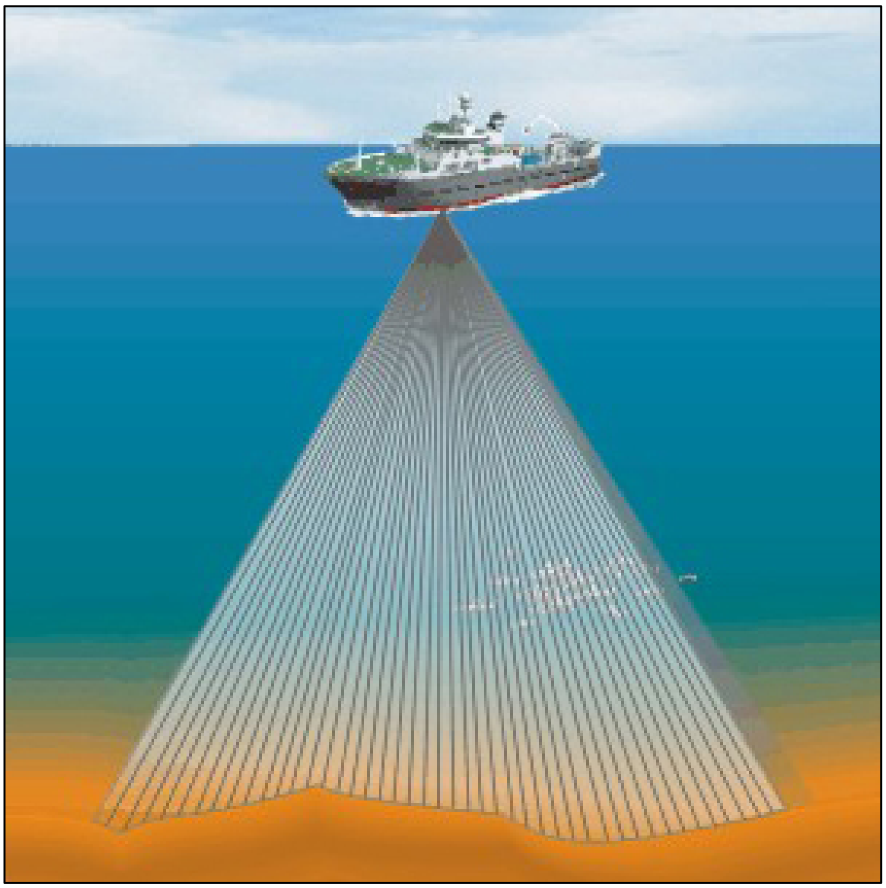

Figure B-23. Multi-beam echosounder
Credit: Simrad – www.kongsberg.com/simrad

The use of multiple acoustic ‘beams’ allows coverage of a greater area compared to single beam sonar. The sensor arrays for multibeam echosounders and sonars are usually mounted on the keel of the vessel and have the ability to look horizontally in the water column as well as straight down. Multibeam echosounders and sonars are used for mapping seafloor bathymetry, estimating fish biomass, characterizing fish schools, and studying fish behavior. The multibeam echosounders used by NEFSC are mounted to the hull of the research vessels and emit frequencies in the 70-120 kilohertz range.

20. NEFSC Vessels used for Survey Activities

NMFS employs NOAA-operated research vessels, chartered vessels, and vessels operated by cooperating agencies and institutions to conduct research, depending on the survey and type of research.

Figure B-24. R/V *Delaware II*

The NOAA research vessel (R/V) *Delaware II* was used for trawl surveys for many years during the Status Quo period considered in this DPEA. It was retired from NOAA service in 2012 and sold so it is not anticipated to be one of the vessels used in the future. The R/V *Delaware II* was a 155 foot steel-hulled, purpose-built research vessel powered by two General Motors diesel engines with a total of 1,230 horsepower (Figure B-24). The R/V *Delaware II* used a single propeller to achieve a sustained cruising speed of 10.0 knots. The deck equipment featured six winches, one deck crane, two A-frames, and a moveable stern gantry. Each of the winches served a specialized function ranging from trawling to hydrographic surveys. The ship had a beam of 30.2 feet and a draft of 14.8 feet, and could accommodate a crew of 32 people including up to 14 scientists for voyages of up to 16 days. The ship's normal operating area was the Gulf of Maine, Georges Bank, and the continental shelf and slope from Southern New England to Cape Hatteras, NC.

Figure B-25. R/V *Henry B. Bigelow*

The NOAA research vessel *Henry B. Bigelow*, shown in Figure B-25, was launched in 2005 to replace the *Albatross IV*. The 209 feet steel-hulled *Henry B. Bigelow* uses an integrated diesel electric drive system, with two 1,542 horsepower propulsion motors, and a single 14.1 feet propeller to achieve a sustained cruising speed of up to 12 knots. The ship has a beam of 49.2 feet and a draft of 19.4 feet and can accommodate up to 39 crew, including 15 scientists, for voyages of up to 40 days. The deck equipment features five winches, one deck crane, two A-frames, and a moveable stern gantry. The ship's primary operating area is offshore waters of the Northeast Continental Shelf LME. The *Henry B. Bigelow* has a number of features engineered specifically to reduce transmission of ship noise into the ocean, which enhances its utility for research because fish and marine mammals are less likely to react to ship noise.

Figure B-26. R/V *Hugh R. Sharp*

The R/V *Hugh R. Sharp*, shown in Figure B-26, is a 146 feet acoustically quiet research vessel operated by the University of Delaware Marine and Earth Studies program, as a member of the University-National Oceanographic Laboratory System (UNOLS). The vessel is powered by a diesel-electric propulsion system with twin Z-drives and a tunnel-style bow thruster. The vessel has a dynamic positioning system, enabling it to maintain a precise location 'on-station' during research activities. It has a nominal cruising speed of 11 knots, and can carry 14 to 20 scientists on cruises up to 18 days in duration. It typically operates in the coastal waters from Long Island, New York, to Cape Hatteras, North Carolina, as well as the Delaware and Chesapeake Bays. Projects occasionally require the vessel to work as far north as the Gulf of Maine, as far south as Florida, and as far offshore as Bermuda. Operational support for the R/V *Hugh R. Sharp* is provided primarily by the National Science Foundation (NSF), the Office of Naval Research (ONR), and the National Oceanic and Atmospheric Administration (NOAA). The R/V *Hugh R. Sharp* is a purpose-built research vessel designed with special attention to controlling underwater radiated noise to minimize effects on the marine environment.

Figure B-27. R/V *Gloria Michelle*

The R/V *Gloria Michelle* is a 72 feet steel–hulled stern trawler operated by NOAA and used for Gulf of Maine shrimp trawl surveys (Figure B-27). The vessel is powered by a Caterpillar 3406 producing 365 horsepower, driven through a single fixed-pitch 64 inches four-blade propeller. The R/V *Gloria Michelle* has a beam of 20 feet, a draft of 9.5 feet, and can accommodate a crew of two officers and eight scientists for voyages up to five days in length.

In addition to NOAA-operated research vessels, research activities may be conducted from chartered or cooperative vessels. A wide range of commercial fishing vessels participate in such cooperative research, ranging from small open boats to modern trawlers and longliners. The sizes of the vessels used for cooperative research, engine types, cruising speeds, etc. vary depending upon the location and requirements of the research for which the vessel is used.

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APPENDIX B
NEFSC RESEARCH CATCH COMPARED TO COMMERCIAL AND RECREATIONAL CATCH

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Target species are those fish which are managed under an FMP, commercially or recreationally fished, and for which stock assessments are conducted using NEFSC-affiliated fisheries research. The 2016 PEA (Table 3.2-1) identified 35 target species encountered during NEFSC-affiliated research activities (2008–2012) that were listed as overfished or subject to overfishing at that time, or for which the average annual research catch exceeded 2,200 pounds (1.1 ton or 1 mt). For the 2016 PEA, the 2,200 pound threshold served as a basis of comparison against the amount of commercial and recreational catch for the purposes of analysis. Since the 2016 PEA analysis, the list of fish has been expanded to include more species (i.e., species with research catch below the 2,200-pound threshold) or to break out specific stocks (i.e., windowpane flounder and yellowtail flounder) to provide a comprehensive evaluation of the potential effects of research on fish species. A complete table showing comparing research catch to commercial and recreational catch is provided here. Commercial estimated discards were attained and added to the 2015 section of the table. Commercial estimated discards were unavailable for 2016 and 2017. Recreational estimated discards were not available at the time of this analysis. Thus, the 2015 section of this table has a more comprehensive comparison between research catch and commercial landings and discards added with recreational landings.

Species	2015 Catch (tons)			2016 Catch (tons)			2017 Catch (tons)			2020 ACL[2] (tons)	2017 Research Catch percent of 2020 ACL
	Combined NEFSC and Cooperative Research	Combined Commercial and Recreational	Research Catch percent of Total Catch[1]	Combined NEFSC and Cooperative Research	Combined Commercial and Recreational	Research Catch percent of Total Catch[1]	Combined NEFSC and Cooperative Research	Combined Commercial and Recreational	Research Catch percent of Total Catch[1]		
Acadian redfish	11.20	5,435	0.21%	13	4,287	0.30%	9.33	5,687.24	0.16%	None[3]	NA
Alewife	3.47	648	0.53%	3.08	653	0.47%	3.19	0.43	88.15%	None	NA
American eel	0	419	0%	0	415	0.00%	0.00	459.23	0.00%	None	NA
American lobster	20	73,507	0.03%	21	79,562	0.03%	18.41	66,720.65	0.03%	None	NA
American plaice	10	1,432	0.68%	4.70	1,227	0.38%	3.13	1,360.86	0.23%	1,565	0.20%
American shad	0.48	46	1.03%	0.24	19	1.25%	0.16	32.93	0.48%	None	NA
Atlantic cod GBK	1.16	1,575	0.07%	2.24	1,748	0.13%	1.77	1,752.02	0.10%	2,405	0.07%
Atlantic cod GOM	3.84	ND[4]	NA[5]	4.04	ND	NA	2.58	ND	NA	734	0.35%

Species	2015 Catch (tons)			2016 Catch (tons)			2017 Catch (tons)			2020 ACL[2] (tons)	2017 Research Catch percent of 2020 ACL
	Combined NEFSC and Cooperative Research	Combined Commercial and Recreational	Research Catch percent of Total Catch[1]	Combined NEFSC and Cooperative Research	Combined Commercial and Recreational	Research Catch percent of Total Catch[1]	Combined NEFSC and Cooperative Research	Combined Commercial and Recreational	Research Catch percent of Total Catch[1]		
Atlantic croaker	6.75	3,409	0.20%	7.20	3,150	0.23%	2.57	3,842.97	0.07%	None	NA
Atlantic hagfish	0.01	1,102	0%	0.01	936	0.00%	0.01	779.13	0.00%	None	NA
Atlantic halibut	0.41	125	0.33%	0.33	144	0.23%	0.34	121.86	0.28%	110	0.31%
Atlantic herring	5.58	87,890	0.01%	14	69,193	0.02%	7.97	54,042.36	0.01%	None	NA
Atlantic mackerel	4.62	10,279	0.04%	3.85	10,866	0.04%	8.14	11,666.51	0.07%	None	NA
Atlantic menhaden	0.12	221,033	0%	0.12	189,135	0.00%	0.12	213,111.02	0.00%	None	NA
Atlantic sea scallop	122	148,735	0.08%	309	168,696	0.18%	18.53	215,459.18	0.01%	None	NA
Atlantic surfclam	10	112,931	0.01%	6.71	105,155	0.01%	0.00	101,939.95	0.00%	None	NA
Atlantic wolffish	0.07	0	98.66%	0.10	0	100.00%	0.12	0.00	100.00%	93	0.13%
Barndoor skate	8.51	75	10.24%	5.05	37	11.96%	6.89	0.00	100.00%	None	NA
Bay and Striped Anchovy	1.99	0.17	92.12%	2.55	0.47	84.58%	0.11	0.01	89.34%	None	NA
Black sea bass	1.74	2,914	0.06%	1.66	3,422	0.05%	1.62	7,717.08	0.02%	None	NA
Blueback herring	0.71	5.22	11.90%	1.37	7.05	16.22%	0.71	2.41	22.77%	None	NA
Bluefish	0.64	5,349	0.01%	3.08	3,281	0.09%	0.54	11,015.72	0.00%	None	NA
Bluntnose stingray	1.70	0	100%	3.48	0	100.00%	1.08	0.00	100.00%	None	NA
Bullnose ray	3.00	0	100%	1.23	0	100.00%	1.51	0.00	100.00%	None	NA
Butterfish	18	2,319	0.76%	9.86	1,316	0.74%	9.49	4,057.65	0.23%	None	NA
Clearnose skate	5.19	94	5.26%	5.14	112	4.40%	2.01	26.74	6.99%	None	NA
Cownose ray	0.32	1	24.43%	4.02	2.01	66.64%	4.14	1.69	71.02%	None	NA
Cusk	1.19	50	2.31%	1.51	43	3.42%	2.05	36.05	5.38%	None	NA
Deep Sea Red Crab	0.02	1,779	0.00%	0.01	1,530	0.00%	0.01	1,506.42	0.00%	None	NA

Species	2015 Catch (tons)			2016 Catch (tons)			2017 Catch (tons)			2020 ACL[2] (tons)	2017 Research Catch percent of 2020 ACL
	Combined NEFSC and Cooperative Research	Combined Commercial and Recreational	Research Catch percent of Total Catch[1]	Combined NEFSC and Cooperative Research	Combined Commercial and Recreational	Research Catch percent of Total Catch[1]	Combined NEFSC and Cooperative Research	Combined Commercial and Recreational	Research Catch percent of Total Catch[1]		
Four spotted Flounder	2.37	6.41	26.97%	2.38	4.63	33.91%	2.50	4.73	34.59%	None	NA
Golden tilefish	0.06	660	0.01%	0.01	557	0.00%	0.07	781.45	0.01%	None	NA
Goosefish (Monkfish) Southern	7.82	5,074	0.15%	18	4,793	0.37%	26.72	4,231.03	0.63%	None	NA
Goosefish (Monkfish) Northern	4.57	0	100%	15	0	100.00%	4.17	0.00	100.00%	None	NA
Haddock GBK	12	5,725	0.21%	36	5,733	0.63%	19.70	6,011.21	0.33%	7,6621	0.03%
Haddock GOM	41	0	100%	21	0	100.00%	17.70	0.00	100.00%	10,611	0.17%
Horseshoe crab	3.92	800	0.49%	4.38	940	0.46%	1.61	1,193.62	0.13%	None	NA
Jonah and R+A52ock Crabs spp.	1.75	7,165	0.02%	1.80	8,141	0.02%	0.97	8,889.96	0.01%	None	NA
Kingfish spp.	1.43	0.32	81.92%	3.78	8.31	31.30%	1.33	914.04	0.15%	None	NA
Little skate	21	4,005	0.52%	20	5,883	0.33%	0.00	4,911.23	0.00%	None	NA
Longfin squid	7.69	13,176	0.06%	7.60	20,083	0.04%	4.40	9,023.20	0.05%	None	NA
Longhorn Sculpin	3.28	3.03	51.96%	2.70	2.02	57.22%	2.38	0.65	78.59%	None	NA
Northern and American Sand Lance	1.85	1.68	52.39%	0.19	1.50	11.29%	0.13	1.51	8.11%	None	NA
Northern sea robin	5.55	56.13	9.01%	3.75	124	2.93%	5.56	4.46	55.51%	None	NA
Northern shortfin squid	0.61	2,670	0.02%	1.57	7,366	0.02%	0.58	24,820.05	0.00%	None	NA
Northern shrimp	0.45	5.86	7.18%	0.99	13	7.01%	0.53	27.94	1.87%	None	NA
Ocean pout	0.57	0.09	85.98%	1.19	0.09	93.20%	0.76	0.01	98.71%	132	0.58%
Ocean quahog	16	124,624	0.01%	66	126,804	0.05%	0.00	129,809.54	0.00%	None	NA
Offshore hake	0.08	0.35	18.71%	0.11	0.33	24.38%	0.04	1.14	3.57%	None	NA

Species	2015 Catch (tons)			2016 Catch (tons)			2017 Catch (tons)			2020 ACL[2] (tons)	2017 Research Catch percent of 2020 ACL
	Combined NEFSC and Cooperative Research	Combined Commercial and Recreational	Research Catch percent of Total Catch[1]	Combined NEFSC and Cooperative Research	Combined Commercial and Recreational	Research Catch percent of Total Catch[1]	Combined NEFSC and Cooperative Research	Combined Commercial and Recreational	Research Catch percent of Total Catch[1]		
Pollock	1.42	4,143	0.03%	1.97	3,123	0.06%	1.97	4,472.77	0.04%	42,113	0.005%
Red drum	7.61	16	32.29%	9.41	21	30.78%	0.65	867.40	0.08%	None	NA
Red hake. Southern	1.04	449	0.23%	1.31	440	0.30%	2.14	446.39	0.48%	None	NA
Red hake Northern	7.77	ND	NA	9.20	ND	NA	12.97	ND	NA	None	NA
Rosette Skate	0.14	0.05	72.93%	0.12	0.01	90.22%	0.05	0.00	100%	None	NA
Roughtail stingray	1.77	0	100%	1.14	0	100.00%	0.96	0.00	100%	None	NA
Round herring	0.07	0.	100%	0.52	0	100.00%	0.00	0.11	2.27%	None	NA
Scup	12	10,748	0.11%	23	10,420	0.22%	17.40	14,491.86	0.12%	None	NA
Sea raven	0.49	0.97	33.82%	0.61	0.32	65.54%	0.57	0.09	86.07%	None	NA
Silver hake southern	4.27	4,761	0.09%	13	3,723	0.35%	1.62	2,933.41	0.06%	None	NA
Silver hake northern	23	ND	NA	23	ND	NA	23.90	ND	NA	None	NA
Smooth Dogfish	9.58	714	1.32%	3.71	492	0.75%	22.28	584.66	3.67%	None	NA
Smooth Skate	1.40	41	3.28%	0.63	86	0.73%	13.90	144.67	8.77%	None	NA
Spanish mackerel	0	224	0.00%	0.01	235	0.00%	0.01	327.17	0.00%	None	NA
Spiny butterfly ray	3.47	0	100%	2.66	0	100.00%	2.34	0.00	100.00%	None	NA
Spiny dogfish	70	9,542	0.73%	159	13,350	1.18%	67	12,063.25	0.56%	None	NA
Spot	1.11	895	0.12%	1.40	196	0.71%	12	4,132.11	0.29%	None	NA
Spotted hake	2.20	0.47	82.38%	2.89	2.28	55.96%	2.30	0.70	76.60%	None	NA
Spotted seatrout	0	32	0%	0	61	0%	0	300	0%	None	NA
Striped anchovy (DNU)	0.02	0	100%	2.19	0	100%	1.43	0	100%	None	NA
Striped bass	0.13	8,536	0.001%	0.46	5,827	0.01%	0.16	21,482	0.001%	None	NA

Species	2015 Catch (tons)			2016 Catch (tons)			2017 Catch (tons)			2020 ACL[2] (tons)	2017 Research Catch percent of 2020 ACL
	Combined NEFSC and Cooperative Research	Combined Commercial and Recreational	Research Catch percent of Total Catch[1]	Combined NEFSC and Cooperative Research	Combined Commercial and Recreational	Research Catch percent of Total Catch[1]	Combined NEFSC and Cooperative Research	Combined Commercial and Recreational	Research Catch percent of Total Catch[1]		
Summer flounder (fluke)	4.00	6,44	0.06%	4.38	4,701	0.09%	4.70	7,873	0.06%	None	NA
Tautog	0.10	1,998	0.00%	0.18	1,623	0.01%	0.50	3,862	0.01%	None	NA
Thorny skate	1.78	312	0.57%	1.48	11	11.99%	2.61	0.03	98.70%	None	NA
Weakfish	8.79	62	12.47%	8.60	79	9.77%	4.61	215	2.10%	None	NA
White hake	3.57	1,809	0.20%	4.89	1,509	0.32%	2.62	2,231	0.12%	3080	0.09%
Windowpane flounder southern	0.81	5.30	13.23%	1.08	5.04	17.61%	4.58	6.09	42.96%	504	0.91%
Windowpane flounder northern	3.91	ND	NA	3.61	ND	NA	0.56	ND	NA	95	0.59%
Winter flounder SNA/MA	1.00	919	0.11%	1.38	704	0.20%	2.01	794	0.25%	772	0.26%
Winter flounder GBK	1.67	947	0.18%	1.24	495	0.25%	0.35	416	0.08%	866	0.04%
Winter flounder CCB/GOM	3.07	120	2.50%	3.76	106	3.37%	2.60	135	1.88%	472	0.55%
Winter skate	49	9,572	0.51%	66	9,750	0.67%	0	9,654	0.00%	None	NA
Witch flounder (grey sole)	17	542	2.99%	1.00	438	0.23%	2.20	491	0.45%	1,045	0.21%
Yellowtail SNA/MA	0.17	358	0.05%	0.08	189	0.04%	1.11	272	0.41%	73	1.53%
Yellowtail flounder GBK	1.04	ND	NA	0.72	ND	NA	0.12	ND	NA	180	0.07%
Yellowtail flounder CC/GOM	1.92	ND	NA	2.59	ND	NA	2.99	ND	NA	540	0.55%
Raja Sp.	166	29,396	0.56%	202	32,168	0.62%	138	45,633	0.30%	None	NA
Combined Stingrays	10.32	2.67	79.42%	13	7.32	63.19%	5.89	4.57	56.31%	None	NA
Gadoids Combined	101	21,456	0.47%	117	21,405	0.54%	89	23,671	0.38%	None	NA
Flounders Combined	47	11,253	0.42%	27	8,317	0.33%	27	11,744	0.23%	None	NA
Herrings Combined	9.86	310,102	0%	19	259,790	0.01%	12	269,220	0.00%	None	NA

Species	2015 Catch (tons)			2016 Catch (tons)			2017 Catch (tons)			2020 ACL[2] (tons)	2017 Research Catch percent of 2020 ACL
	Combined NEFSC and Cooperative Research	Combined Commercial and Recreational	Research Catch percent of Total Catch[1]	Combined NEFSC and Cooperative Research	Combined Commercial and Recreational	Research Catch percent of Total Catch[1]	Combined NEFSC and Cooperative Research	Combined Commercial and Recreational	Research Catch percent of Total Catch[1]		
Dogfish Combined	80	10,308	0.77%	163	13,922	1.16%	90	18,067	0.49%	None	NA
Tunas/Mackerels	4.62	10,662	0.04%	3.86	11,840	0.03%	8.14	20,927	0.04%	None	NA
Skates/Stingrays Combined	193	29,928	0.64%	227	32,447	0.69%	56	46,229	0.12%	None	NA

[1]Commercial skate discards not separated by species, so skate discard data combined with commercial landings and recreational landings and compared to combined research skate catch.
[2]Bay and Striped Anchovy commercial landings and discards are unreliable. Disregard comparisons for Bay, Striped, and combined.
[3]Commercial stingray discards not separated by species, so discard data combined with commercial landings and recreational landings and compared to the combined research stingray catch.
[4]Commercial discards for sculpins were not separated by species, so sculpin unclassified discard data was combined with commercial landings and recreational landings and compared to combined Northern Sea Robin, Sea Raven and Longhorn Sculpin research catch.
[5]No commercial discard data was available for four-spot flounder. Use Flounder unclassified as a proxy for four-spot flounder.
[6]No commercial discard data for sand lance species and commercial landings data are unreliable.
[7]Kingfish Sp., Red drum, and Weakfish could have benefitted from discards from recreational fisheries but were not included.